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THE ANIMAL CREATION.

THE

ANIMAL CREATION:

A Popular Introduction to Zoology.

BY

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TO

PROFESSOR THOMAS BELL, F.R.S.

ETC., ETC., ETC.

THE FOLLOWING INTRODUCTION TO A SCIENCE

SO ABLY ILLUSTRATED BY HIS WRITINGS,

Is Inscribed

AS A TRIBUTE OF RESPECT AND ESTEEM

BY

HIS FRIEND AND COLLEAGUE,

THE AUTHOR.

INTRODUCTION.

In the present volume it has been the endeavour of the Author to give, with as much conciseness as is compatible with the subject, a general view of the principal families into which the Animal Creation has been grouped by modern Zoologists; together with such notices of their characteristic habits and instincts as are to be gleaned from various writers in every department of Natural History. These, it is hoped, will be interesting to the general reader, and at the same time afford the student at least a bird's-eye view of the extensive field upon the investigation of which he is desirous of entering.

LIST OF PLATES.

THE ANIMAL CREATION;

A POPULAR INTRODUCTION TO ZOOLOGY.

CHAPTER I.

THE science of Zoology teaches us the forms and habits of the countless animals with which we are everywhere surrounded, their mutual dependencies upon each other, and their relative importance in the economy of Nature. Among the innumerable beings which crowd this world not one is idle; all are actively employed each in its separate sphere of usefulness, and though they blindly do the work imposed upon them by their Great Creator, ignorant of other's ways, the grand result is perfect harmony.

When we consider how innumerable are the species of animals distributed over the whole surface of the earth, and throughout the immeasurable realms of water, and are called upon to recognise them individually, and to identify all the members of such a multifarious host, the task might well be considered as hopeless as that of the unlettered savage who, unable to count beyond twenty, sets about the enumeration of the stars, and tries to fix their places and assign their names. Yet even those stars have been reduced to order, the very skies have been mapped out, and the astronomer points with as much satisfaction to the buckle of Orion's belt or the tip of the nose of Bootes, as if these respectable gentlemen were up on high sitting for their portraits.

A disbanded army presents to the observer nothing but a wild scene of inextricable confusion; but when at trumpet-call, the soldiers hasten to their ranks, and the appropriate banner waves above each company, these companies fall into regiments, and the living mass, directed by one chief, moves on with the utmost order and regularity.

Systematic arrangement is, therefore, the very foundation of the science of zoology: it is only by the establishment of classes, and orders, and genera, and species, which constitute, so to speak, the colours of the different regiments, that such arrangement is, at all, to be accomplished, and to define the limits and the characters of these genera and species, the efforts of the scientific zoologist are principally directed. It must, consequently, be our first endeavour to explain what these words, species and genera, mean.

By **Species** is understood a number of animals so closely resembling each other, that they all might be supposed to be the offspring of the same parents, and in turn to give birth to progeny, exactly resembling themselves. The *domestic mouse*, for example, is a species, the exact fac-simile both of its ancestors and its offspring. Species, however, may be slightly modified by the continued operation of external circumstances, such as climate, abundance or deficiency of food, or other similar accidents; there may, for example, be a white mouse, or a piebald mouse; these are called **Varieties** of the species.

A **Genus** is a group embracing a number of species which have a striking general resemblance to each other in certain important particulars, whereby they are distinguishable from all other animals. The *domestic mouse* (*Mus musculus*), for instance, is at once recognisable from the squirrel, the beaver, or the hare, from the circumstance that it has a long tail tapering to a point and denuded of hair; but there are many other animals which, though evidently not real mice, have this feature in common. There is the rat, *Mus rattus;* the brown rat, *Mus decumanus;*

the field mouse, *Mus sylvaticus;* and the harvest mouse, *Mus messorius,* all of which are species more or less resembling the **Mouse**, but all distinguishable from each other by minor characters; these, therefore, constitute a *genus.*

An **Order** is a far more extensive group, including several genera, allied to each other by some important feature in their economy. The rats and the mice, for example, are all remarkable for their chisel-like front teeth, but there are other animals that have their teeth of the same construction, although they have not the same long and tapering tail, *e.g.*, the squirrel, the beaver, the hare, and the porcupine; these, therefore, form the order **Rodentia**, or animals distinguished by their chisel-like teeth.

A **Class** embraces all the Orders related to each other by some grand and general character possessed by them all in common. Thus, the Rodentia suckle their young, but so do dogs, so do monkeys, hedgehogs, cats, whales, elephants, cows, ant-eaters, and kangaroos; a circumstance whereby they are distinguished from birds, reptiles, or fishes. All animals that give suck are, therefore, associated to form one great class—the **Mammalia**.

Or we may take the converse of all this. Thus, in the animal kingdom there is a **Class** of creatures recognisable by the circumstance that they suckle their young; among these is an **Order**, distinguished by having chisel-like teeth in the front of their mouths; belonging to this Order is a **Genus**, remarkable for the possession of a long tapering tail, and the smallest **Species** belonging to this genus is the harvest mouse, **Mus Messorius**. An arrangement such as this enables us to find out the name of any animal, and is called a *system*, which, in fact is a dictionary with this difference, that here the properties enable us to find out the name, whereas in ordinary dictionaries, the known name serves to acquaint us with the properties. Thus, the study of Zoology is one eminently calculated to accustom the mind to habits

of order and precision, to a close and accurate comparison of objects presented to our notice, and to a clear and neat perception of their distinctive characters; it gives a facility of expression to our descriptions, and in this way its importance, as a branch of education, can scarcely be exaggerated.

Perhaps nothing has contributed so much to the advancement of the science of Natural History as the happy expedient first adopted by Linnæus, of giving to every object in Nature a double name, whereby its identity is at once satisfactorily indicated. Thus, in the examples given above, we say *Mus musculus, Mus rattus, Mus messorius.* The first of the two names is that of the genus, and, therefore, common to all the species of that genus; the second is the *specific name* —that is, points out the species to which we refer, just in the same manner as in the names of persons. The family name Milton or Shakspeare may belong to anybody, but John Milton and William Shakspeare are individuals at once recognisable. The only difference is that in this case the specific name is placed first, instead of after that of the genus. To understand the importance of this great step in Zoological Science, it is only necessary to read the descriptions of old authors who, after devoting half a page to the identification of an animal, leave you in doubt whether they are speaking of a cat, a rat, or a hippopotamus.

With regard to the classification of the immense series of living beings composing the animal creation, various *systems* have been at different times sketched out by the master minds of science, all of which have more or less fallen short of their great object. Of these, the most useful and most generally adopted is that of Cuvier, and as this will be more or less our guide throughout the following pages, a knowledge of its leading features becomes indispensable.

According to the system of Cuvier, all living animals are divided into—

1st. Those that have back-bones (*vertebræ*);

2nd. Those that have not back-bones.

Those animals that have back-bones are called—
Vertebrate.

Those that are without back-bones are called—
Invertebrate.

The Vertebrate division includes—
Fishes, Reptiles, Birds, and **Mammals.**

The **Invertebrate** division is much more numerous, and comprehends animals of very various construction; these are—

1st. **Mollusks,** or soft-bodied animals, such as *cuttle-fishes, snails, oysters,* &c.;

2nd. **Articulated Animals,** or animals enclosed in a jointed skin, such as *insects, spiders,* and *lobsters;*

3rd. **Radiated Animals,** under which head are included all the lowest, and least perfect members of the animal kingdom, many of them having few characteristics in common.

The completeness of the above classification, so far as it relates to the more perfect animals, is generally admitted, and we shall, therefore, take it as our guide; but among the lower tribes of creation such guidance fails us, and through this labyrinth we shall have to make our way by the aid of more recent investigations.

In the preceding paragraph, as the reader may have remarked, we have spoken of "the more perfect animals" as contradistinguished from those of "the lower tribes," and as we shall again and again be obliged to have recourse to similar expressions, the terms require some explanation. Every animal is perfect in its kind, and to add to, or to take from, its attributes would deteriorate its usefulness in creation. By the perfect or imperfect structure of an animal we simply mean the degree in which it approximates to Man, the type and pattern of zoological perfection, just as in estimating the value of money, we take the highest coin of the realm as a standard of comparison. Man, the paragon of animals, is the union of what is most perfect and beautiful in them all.

Hence, animals which have a resemblance to Man, are not without reason styled perfect in a degree proportioned to that resemblance.

With these preliminary observations, we enter on our pleasurable task, and proceed to trace the varied forms of animal existence from the first dawn of life to Man himself, who, standing supreme in his mental capacities, rises by his immortal destiny incomparably beyond them all.

Turning our attention to the great scene before us, "Beast, bird, fish, insect, which no eye can see, no glass can reach," so strange and diversified are their shapes and attributes, that the student naturally inquires, What is an animal? a question which he will soon find to be much more easily propounded than satisfactorily solved.

At the first glance of the superficial observer, the distinctions between the animal and vegetable kingdoms seem plain and obvious. We all know a cow from a cabbage, a horse from the grass upon which it feeds; and yet, as we come more closely to scrutinize forms of life less violently contrasted, doubts and hesitations soon begin to teach us that the discrimination is not always so easy, and that at length the differences between the animal and the vegetable creations become almost imperceptible. Light and darkness seem distinct enough, and no one possessed of eye-sight could be in danger of mistaking noon for night; but he who gazes on the morning's dawn, and tries to mark the line that separates the parting darkness from the coming day, will find the task by no means an easy one, so gently do the lights and shades tincture and mingle with each other.

The axiom of Linnæus is well-known. "Stones grow, vegetables grow and live, animals grow, live, and *feel*." The capability of feeling, therefore, was regarded by the great Swedish naturalist as the distinctive character of an animal; but how can we define where feeling has been first bestowed. The sensitive plant which coyly shrinks upon the slightest

touch, does it not feel? The flower that shuts its bells as evening comes, and seems to go to sleep, is it insensitive? We cannot tell.

To move from place to place, to have the power of locomotion, has been said to be an attribute of animals, whereby they are distinguishable. Yet although we see the *Volvox*,* (Fig. 1), rolling through

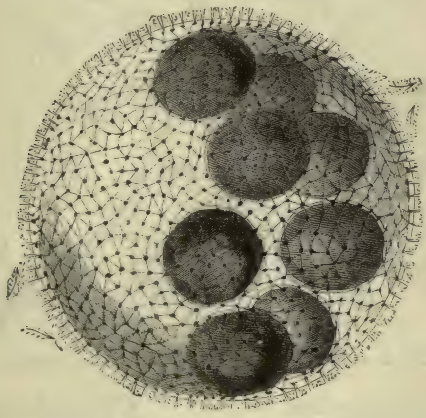

FIG. 1.—VOLVOX.

the drop that forms its space with slow majestic movement, wielding upon its surface countless living filaments, we are forced to believe the chemist who informs us that it is a vegetable.†

If we take a drop of water from any stagnant pool and place it under a microscope, we shall soon perceive that it contains a great variety of living organisms, very diverse in their shape, and all equally

* Volvo, *I roll.*

† The Volvox globator, of which a figure is given in the text, is acknowledged to be a vegetable production. In shape it seems a microscopic globe, rolling slowly on its axis. More accurately examined, we perceive the body to be formed of a transparent spherical membrane, studded with small green dots, and having all its surface covered over with vibrating filaments of infinite minuteness, which produce currents in the surrounding water, and thus cause the revolution of the little sphere, as well as its progression.

remote in their structure and appearance from any with which we are elsewhere familiar. Let the reader cast his eye for a moment upon the annexed engraving (Fig. 2), which represents a piece of duckweed gathered from a neighbouring pond, surrounded

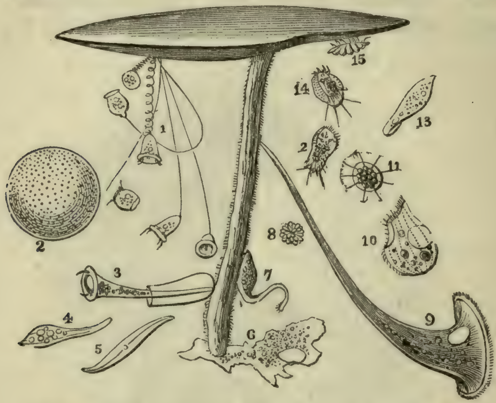

FIG. 2.—MICROSCOPIC OCCUPANTS OF A LEAF OF DUCKWEED.
Highly Magnified.

1. *Vorticella convallaria.*
2. *Volvox globator.*
3. *Vaginicola crystallina.*
4. *Amphileptus fasciola.*
5. *Navicula hippocampus.*
6. *Amœba diffluens.*
7. *Trachelocerca olor.*
8. *Polytoma uvella.*
9. *Stentor polymorphus.*
10. *Bursaria truncatella.*
11. *Pandorina morum.*
12. *Stylonychia mytilus.*
13. *Paramecium aurelia.*
14. *Euplotes truncatus.*
15. *Euplotes striatus.*

by the microscopic creatures that live in its vicinity. Some fixed upon the stem (Fig. 2, 9) like trumpets in their shape, spread out their gaping mouths, around which whirl the swarming atoms that they swallow; others, like wine-glasses in miniature, stretch out the little bells that constitute their bodies, to the length of their transparent stems in search of food, or if alarmed, folding their stalks in spiral revolutions, shrink timidly from danger (Fig. 2, 1).

The Volvox (Fig. 2, 2) silently revolves, a little world within itself. Others (Fig. 2, 6) of different shape, resemble films of ever-changing cloud. Others,

again, transparent globes of jelly (Fig. 2, 11), shoot forth star-like rays in all directions. Some have the form of glass-like shuttles, coloured with bright green contents, creeping more slowly than the hour hand of a watch along the bottom. Some (Fig. 2, 8) have the shape of rolling mulberries, that gently make their way through the surrounding water. Others (Fig. 2, 7), like swans in form, glide up and down with graceful elegance. The *vaginicola* * (Fig. 2, 3) lives in a crystal vase, from which it stretches itself forth in search of nourishment. The *Paramecium* † (Fig. 2, 13), like a meteor, shoots along, prowling in all directions; some (Fig. 2, 14, 15), clad in shells, and armed with leg-like hooklets, creep much after the manner of insects: while others skip from point to point like living scintillations. Such are the creatures that we find in swarms in every stagnant ditch, as any one possessed of a very ordinary microscope may soon convince himself. These wonderful organisms have little resemblance to each other. It is difficult, indeed, with the exception of their miraculous minuteness, to fix upon any character that they possess in common. We are not surprised, therefore, that by the earlier observers with the microscope, they were all grouped together under the very extensive designation of **Animalcules**, a term simply significative of their small size, or of **Infusorial Animalcules**, in allusion to the circumstance that they are generally met with in infusions of animal or of vegetable substances, and are easily attainable by exposing such infusions to the atmosphere.

Modern improvements in the microscope, and a close attention to the habits and organization of the creatures under consideration, have, however, revealed to us the startling fact that in the drop of water under contemplation, we have examples of no fewer than three distinct classes of organisms: one belonging to the vegetable, and two to the animal series of creation. By using a very simple test, namely, the

* Vagina, *a sheath*, colo, *I inhabit*. † παραμήκης, paramekes, *oblong*.

addition of a little iodine to the drop in which they swim, it is found that four specimens in the little group before us, namely, the *Volvox* (Fig. 2, 2), the *Polytoma* (Fig. 2, 8), the *Navicula* (Fig. 2, 5), and the *Pandorina* (Fig. 2, 11), at once turn blue, indicative that they contain *starch*, a substance thought to be peculiar to the vegetable creation, and thus confess that they are vegetable productions.

The slimy substance of the *Amœba diffluens* (Fig. 2, 6), that we have stated to be continually changing its shape, like the outline of a cloud, refuses to alter its colour under such a test; and, moreover, as it flows or glides from place to place, is seen to devour and to digest the materials with which it is surrounded, thus claiming admission into the animal series, and soon making good that claim by exhibiting attributes and capabilities decidedly of an animal character. The remaining forms (Fig. 2, 1, 3, 4, 7, 9, 10, 12, 13, 14, and 15), more active and energetic in their movements, and evidently of higher capabilities, are all distinguished by having their bodies either partially or entirely covered with a wondrous machinery of vibrating hair-like appendages, which, from their resemblance to our eye-lashes, have been named cilia.* By the assistance of these admirable organs, the little creatures possessing them are rowed rapidly about from place to place, or causing whirlpools in the surrounding water, drag towards their mouths the tiny victims upon which they feed. The vegetable forms above mentioned are known to botanists under the names of *Diatoms*,† *Desmidiœ*,‡ *Confervæ*, &c. The slime-like animals are called by zoologists **Rhizopods**, while the ciliated forms are distinguished by the appellation of **Infusoria.**

These, then, are the usual occupants of a drop of water, the contemplation of which cannot but excite the curiosity of the spectator, and call forth his warmest admiration. Curiosity will, however, per-

* Cilium, *an eye-lash.* † δίατομος, diatomos, *divided.* ‡ δεσμὸς, desmos, *a band.*

haps assume a deeper interest, when he still more closely examines their history.

There are in Sweden certain extensive tracts of country entirely composed of an exceedingly fine earth, which, from its whiteness and from an idea extensively prevalent, that it possesses nutritious properties, has long been distinguished by the name of *Bergmehl*, or "mountain meal." A little of this earth, for long ages trodden under foot, submitted to the modern microscope, has revealed itself to be

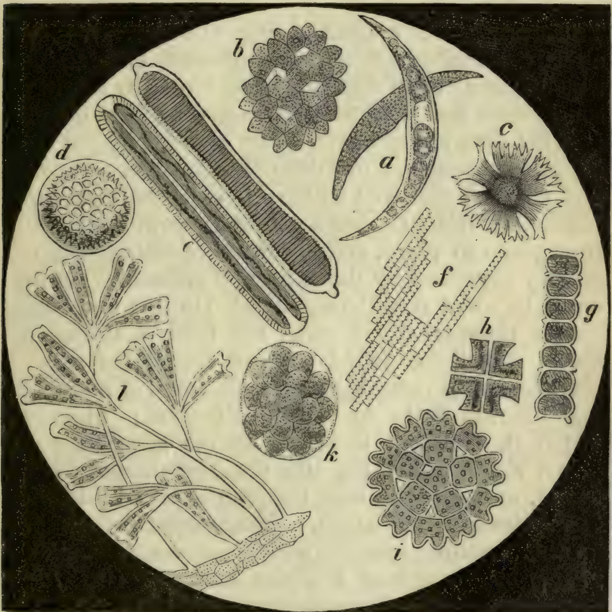

FIG. 3.—VEGETABLE FORMS OF MICROSCOPIC ORGANISMS.

entirely resolvable into minute shells of exquisite beauty and delicacy of sculpture. These shells, being composed almost entirely of pure flint (*silex*), are almost indestructible, and to a practised eye are at once seen to have belonged to vegetable organisms

resembling those represented in our engraving (Fig. 2, 5), which must have lived for ages in some quiet lake, whose waters covered the vast area where they are found, and as they perished, sinking to the bottom, left their shells records of their history.

CHAPTER II.

RHIZOPODA* (*Root-footed animalcules*).

To return to our magnified drop of water. We have already described the *Amœba diffluens*† (Fig. 2, 6), as resembling a film of ever-changing cloud, so soft in its consistence that it is but a little removed from fluidity. It is not firm enough even to be called jelly: it may almost be compared to a drop of gum-water or mucus, and yet it is endowed with very extraordinary capabilities. It evidently has a voluntary power of moving from place to place, and its mode of doing so is not inaptly expressed by the epithet "diffluens," *flowing-away*, by which it is distinguished. On first perceiving one of these creatures under the field of the microscope, it will be found perhaps contracted into a shapeless mass resembling a small patch of mucilage, and offering little to attract attention; while we watch it, however, it begins to move, spreads out into a shape something like that represented in our figure, and we are almost tempted to make a drawing of so strange a creature. Meanwhile, it flows into another outline, spreading like water spilled upon a greasy board, and so it glides from place to place, and form to form. This microscopic film is hungry too, and eats; but having neither mouth nor stomach, it is not at first easy to conjecture how such a feat can be accomplished. Its body is generally seen to contain the shells of Naviculæ (Fig 4), and other similar

* ῥίζα, rhiza, *a root*; ποῦς, ποδὸς, pous, podos, *a foot*.
† ἀμοιβὴ, amoibe, *change*.

organisms; it does not seem to swallow them, but overwhelms them with its semifluid substance, and

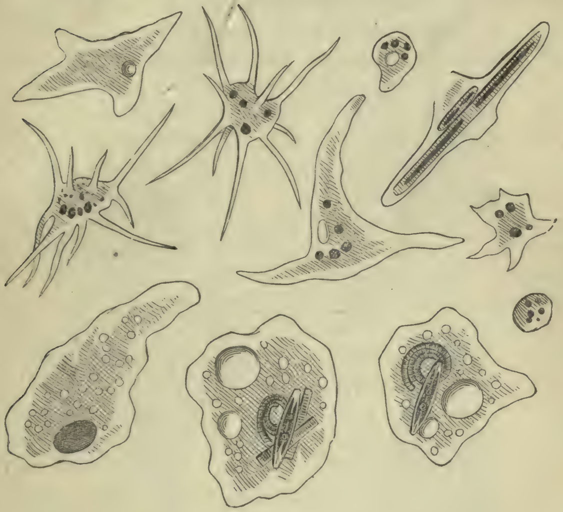

FIG. 4.—AMŒBA.

as it passes over them, dissolves whatever is digestible, and then casts forth their empty shells.

The sea-side visitor, who will be at the trouble of placing a little sea-weed, fresh gathered from the rocks, in a glass vessel filled with its native element, and allowing it to remain for a few hours undisturbed, will occasionally find, clinging to the sides of the glass, filmy patches, so small as to be inconspicuous, except with the assistance of a lens, which change their form and glide along with slow but equable movement. When magnified, their central body will be seen to throw out threads resembling filaments of melted glass, which spread like roots in all directions, and as these creatures seem to use their

root-like filaments as feet, they are named **Rhizopods**—that is, root-footed animals. They are, in truth, marine forms of the *Amœba* we have just been describing, from which, however, they differ in being

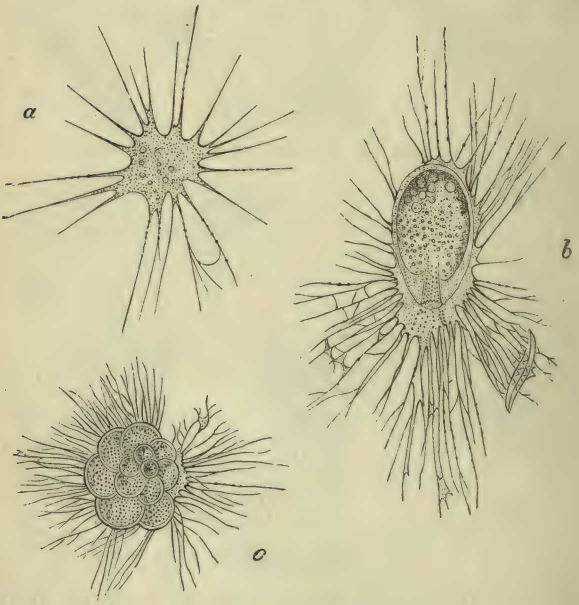

FIG. 5.—RHIZOPODS.

able to construct for themselves shelly coverings, perforated by innumerable little orifices or *foramina*, through which their root-like filaments (*Pseudopodia*)* are protruded; from this circumstance, the shells and the creatures inhabiting them have been named **Foraminifera.**† Minute as these shells are, invisible for the most part to ordinary vision, the microscope reveals many of them to be structures of exquisite beauty, emulating in their shape the

* False feet. ψευδὴς, pseudes, *false*; ποῦς, pous, *a foot*.
† Foramen, *an orifice*; fero, *I carry*.

model forms of ancient vases, and presenting an elaborate sculpture surpassing that of Chinese carvings in their decoration.

It is not, however, from their beauty, but from the numbers in which they exist, that these and similar organisms derive their chief importance. Few visitors at the sea-side can have failed to observe that often in the summer-time the waves are luminous, and shine with phosphorescent splendour. The ripples as they totter towards the beach sparkle with scintillations, and the crested waves blaze with a pale but brilliant light. The fisherman, who from his boat surveys the lambent flames that play around him, seems to float in fire. The mariner can trace his path by the long wake of light that streams behind like the train of some vast sky-rocket, or looking from the prow, he sees his vessel as she breasts the waves, dash from her bows broad sheets of liquid splendour. As morning dawns the fairy vision vanishes, nor can the keenest eye perceive in the translucent element the tiny lamps that caused the grand illumination.

Night comes again, again the sea, lit up, repeats the glorious lesson. Not a breeze sweeps over its tranquil surface but evokes a flash of splendour that extends for miles, and emulates the lightnings of the skies ; and so from day to day the gallant ship sails on, from week to week, from month to month, the mighty ocean, through its wide extent, renews each night the impressive spectacle.

If we inquire into the cause of a phenomenon thus widely extended, it will be found in every part of the world to depend upon the presence of infinite myriads of living atoms resembling those we are discussing. On taking a glass of the sea-water thus made luminous, it will be found that every sparkle is a brilliant point of living substance such as forms the Rhizopods described above (Fig. 6).

We have as yet spoken only of the simplest of these animals, but by far the greater portion of the

Foraminifera are composite fabrics. The **Rotalia** * (Fig. 5), for example, might almost be taken for the

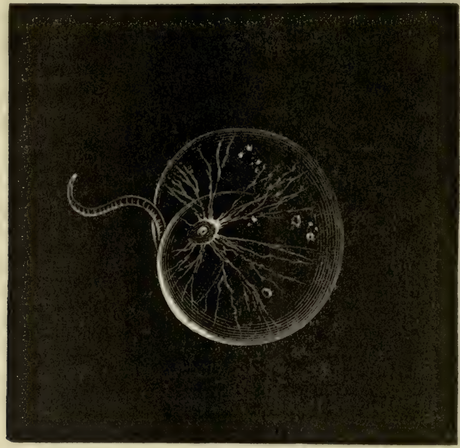

FIG. 6.—FIGURE OF NOCTILUCA MILIARIS.

shell of a microscopic nautilus, nay, has been so mistaken even by the most eminent zoologists. These exquisite structures consist of a series of compartments, in the interior of which the semifluid substance of the animal is lodged. The walls of each of these compartments are perforated with innumerable holes, through which the slender glass-like filaments protrude in all directions to a considerable distance, so that the shell in which the main body of the creature is encased, has somewhat the appearance of a spider sitting in the centre of its web.

These semifluid filaments (*Pseudo-podia*) also constitute the prehensile organs of these simple beings. Any small objects serviceable for nutriment with which they come in contact are laid hold of apparently by the viscidity of their surface, and except they are animalcules of considerable size and power, they are unable to escape. When a filament has so seized its

* Rota, *a wheel.*

prey, adjoining fibres aggregate about it and coalesce, a current of the viscous substance, so to speak, sets in towards the spot, and very soon envelopes the object in a thin film. The prey being thus secured, the glairy cords shorten themselves and draw it towards the chief mass or body of the animal, or else the object seized continues in the same place, and the whole organic substance moves towards it, the result being in either case that it is engulphed and dissolved.

The size of the Rhizopods is exceedingly minute. Ehrenberg describes Amœbœ, the dimensions of which range from $\frac{1}{2800}$th to $\frac{1}{70}$th of an inch. The largest fresh water forms only attain a diameter of $\frac{1}{32}$nd part of an inch, whilst the largest marine species, which are just visible to the naked eye, do not measure more than from $\frac{1}{26}$th to $\frac{1}{9}$th of an inch.

Notwithstanding their minuteness, however, the reader will now begin to perceive that these humble creatures, diffused in countless multitudes through every sea, and cased in shells of such exquisite workmanship, are by no means unimportant agents in the economy of Nature. Their numbers make up for the minuteness of their dimensions, and assiduously employed as they have been from age to age, we are not surprised to find that they, like the vegetable forms described in the last chapter, have been important agents in the construction even of extensive geological strata.

The extraordinary abundance of foraminiferous shells in the sand of some sea-shores has been long observed; Plancus, in 1739, counted, with the aid of a low magnifying power, 6,000 individuals in an ounce of sand gathered at Rimini, upon the shores of the Adriatic sea. D'Orbigny states that 3,840,000 exist in an ounce of sand from the Antilles; and Schultze counted 500 shells in the $\frac{1}{6}$th of a grain of sand collected from the mole of Gaeta on the shores of the Mediterranean.

Ehrenberg describes finding chambered shells such as we have delineated both on the surface of the sea, and

also on the bottom, even at a depth of 12,000 feet. From these great depths they are procured by soundings; the sounding-lead, after being coated with grease, brings up attached to it the small particles with which it comes in contact. Numerous such soundings were taken by Sir James Ross in his Antarctic expedition, and have been practised by others in different regions. Dr. Barclay records the results of a series of deep sea-soundings made in the Atlantic, over a considerable geographical area, from latitude 42° 4′ to latitude 54° 17′ at depths varying from 1,080 to 2,000 fathoms. "None of the soundings contain a particle of gravel, sand, or other unorganized matter. They all agree in being made up entirely of the shells of Foraminifera." There is, therefore, little doubt that the bottom of the ocean is in many localities covered, perhaps to considerable depths, by a sedimentary deposit, consisting principally of shells of this description, and which, were they raised to the surface, would constitute thick beds of incalculable extent.

In a fossil condition, the shells of the Foraminifera enter largely into the composition of the crust of the earth in every part of the world. They form by far the most important constituent of chalk wherever that substance is met with. Dr. Barclay speaks of them as importantly concerned in the formation of the tertiary rocks of South Carolina, and adds, "they are still at work in countless thousands on that coast, filling up harbours, forming shoals, and depositing their shells to record the present state of the sea-shore as their predecessors, now entombed beneath Charlestown, have done with regard to ancient oceans."

In many parts of the world the accumulation of these shells has given origin to widely-extended strata, many hundreds of feet in thickness. Mountains of Nummulitic limestone, entirely composed of them, extend through the Alps and Northern Italy, and are met with in Greece, Syria, and Northern India The Mokkadam range, from which the stone used in building the Pyramids was obtained, are simply masses of foraminiferous shells. According to M. Deshayes, there is found in most of the stone from which Paris is built, as large a proportion of the shells of Foraminifera as of particles of sand, so that it may be said, almost without exaggeration, that even Paris owes

the materials of which it is constructed to the persistent agency of these microscopic organisms.

Thus we perceive a film of living slime—for such essentially these creatures seem to be, moulded into a thousand beauteous forms, labouring incessantly—has silently produced results on which we can but gaze with awe.

CHAPTER III.

SPONGES.*

THERE seems to be little relationship between the Foraminifera we have just been speaking of and the race of sponges—in fact, few things could be pointed out more unlike each other. Infinitely

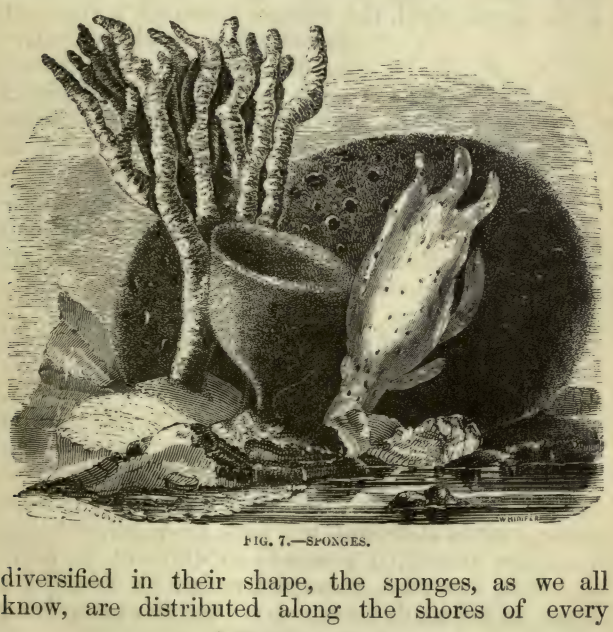

FIG. 7.—SPONGES.

diversified in their shape, the sponges, as we all know, are distributed along the shores of every

* Spongia, *a sponge.*

climate; some overspread the surface of the rocks like living carpets, others expand in fan-like growths of softest texture; some are cylindrical in shape, while others emulate the forms of branching shrubs; others, again, are moulded into cups and giant goblets, many festoon the walls of rocky caverns, or depend, like living stalactites, from wave-worn roofs. Examined with a microscope, however, a living sponge is found to differ but little from the organisms we have just been contemplating. No matter what its form, the living portion of a sponge consists of a soft slime that coats each fibre of its structure, and this soft slime, when highly magnified, resolves itself entirely into particles so like the Amœba in their characters and attributes, that they are evidently of the same nature, the main distinction being that, whereas in the case of the Foraminifera, they secrete a calcareous shell, the sponges construct a common framework, over which the living film is spread. This framework varies in its composition in different kinds of sponge. Sometimes it is made up of tubes of horn, forming a network interlaced in all directions; such is the common sponge of commerce, which owes its resiliency and its capability of absorbing and retaining fluids, qualities which render it so useful in domestic economy, to the construction of its horny skeleton. Instead of tubes of horn, the sponges usually found upon our coasts deposit in their substance crystals of pure flint, which vary much in form in different kinds, while a third group strengthen their framework with calcareous spicula of variable shape. Three different kinds of sponge may, therefore, grow close to each other, bathed alike with the same sea-water, yet they elaborate therefrom products so different as horn, and flint, and lime, wherewith to build a fabric that supports the whole community. On viewing a living

FIG. 8.—FRAMEWORK OF SPONGE.

sponge in sea-water with care and attention, it is found to exhibit a constant and energetic action,

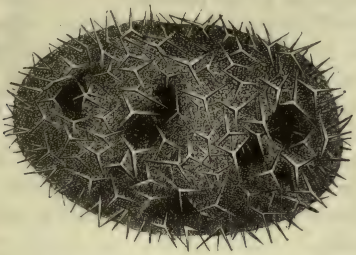

FIG. 9.—FLINT CRYSTALS OF SPONGE.

which sufficiently shows its vitality. Dr. Grant's account of the discovery of this motion in a native species is very interesting.

"I put a small branch of a *spongia coalita* with some sea-water into a watch-glass, under the microscope, and on reflecting the light of a candle through the fluid, I soon perceived that there was some intestine motion in the opaque particles floating through the water. On moving the watch-glass, so as to bring one of the apertures on the side of the sponge fully into view, I beheld, for the first time, the splendid spectacle of the living fountain vomiting forth from a circular cavity an impetuous torrent of

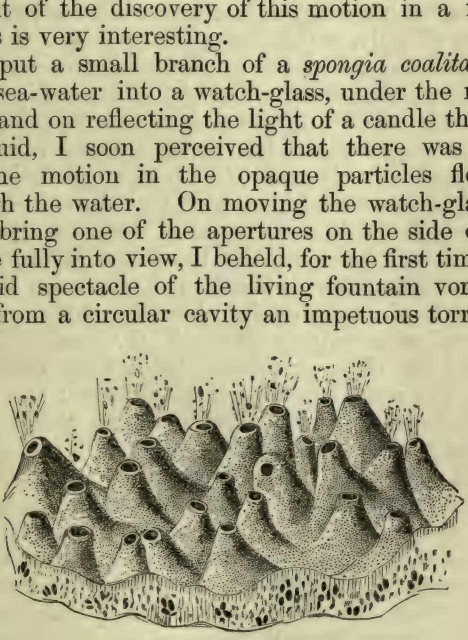

FIG. 10.—SPONGE IN ACTION.

liquid matter, and hurling along, in rapid succession,

opaque masses, which it strewed everywhere around. The beauty and novelty of such a scene in the animal kingdom long arrested my attention; but after twenty-five minutes of constant observation, I was obliged to withdraw my eye from fatigue, without having seen the torrent for one instant change its direction, or diminish in the slightest degree the rapidity of its course. I continued to watch the same orifice at short intervals for five hours, sometimes observing it for a quarter of an hour at a time; but still the stream rolled on with a constant and equal velocity."

The sponges perpetuate their race by a very curious mode of increase. At stated periods there project from the interior of the larger canals, that traverse their substance in all directions, minute oval masses of jelly, which grow, till at length they are detached and driven out by the issuing currents into the surrounding water. One would naturally expect that such apparently helpless atoms would fall at once to the bottom; but in such a case how could the species be dispersed? Here we behold with wonder a beautiful instance of providential care. A power of locomotion is conferred upon the offspring, which is not possessed by the parent sponge; for, whereas the latter is firmly rooted to the bottom, incapable of changing its place, the little germ is able to swim rapidly through the sea. This is effected by cilia, or minute hairs, with which one end of the pear-shaped gemmule is beset; these constantly keep up a rapid vibration, and thus row the embryo sponge from place to place, until it reaches a distant and suitable spot, where it quietly settles down, and soon takes the form peculiar to its species.

Were we to inform our young readers that flints have been sponges, and that every flint wherewith, in many parts of the country, the roads are paved, and which, before the invention of lucifer matches, constituted almost the only means of obtaining fire, had grown at the bottom of the sea, rooted upon rocks,

and sucking in the surrounding water through innumerable pores upon their surface, which conveyed through every part of their soft texture materials for their subsistence, we could scarcely expect the assertion to be credited, at least, without considerable hesitation; and yet no fact in natural history is more easily demonstrated. Not only do the fragments of flints examined under the microscope reveal the fossilized texture of the sponge, but not unfrequently the shells of the animalcules upon which they lived are found in their substance, and even portions of the sponge itself, as yet unpetrified, are often contained in their interior.

FIG. 11.—HALICHONDRIA OCULATA.*

* ἅλς, hals, *the sea*; χόνδρος, chondros, *cartilage*.

CHAPTER IV.

INFUSORIA* (*Ciliated animalcules*).

RETURNING once more to our examination of the drop of water which has already furnished us with lessons of such interest, we find it still offering to our notice animalcules widely different in their

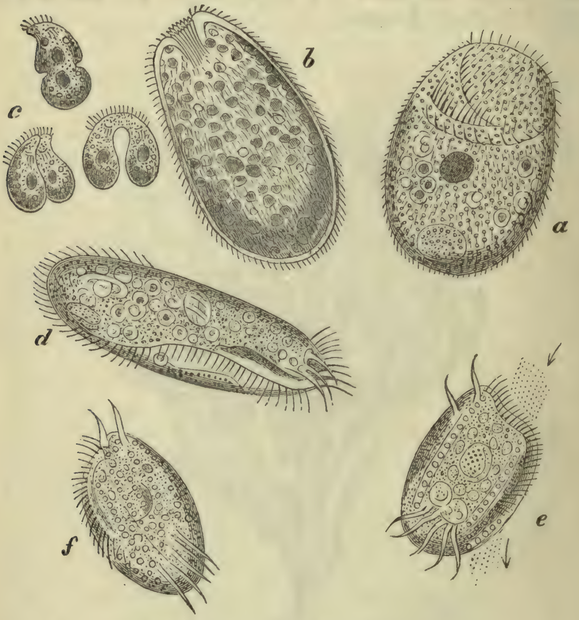

FIG. 12.—PARAMECIUM, &C.

structure from any that we have as yet encountered. They are all of them, however, distinguishable by one striking feature in their economy—namely, that

* Met with in stagnant water.

they are propelled through the water by means of vibratile cilia, which are sometimes distributed over the entire surface of their bodies, while in others these wonderful organs are restricted to certain parts, more especially to the vicinity of the mouth. The possession of a *mouth*, as the reader will at once perceive, is in itself an important character, whereby they are broadly separated from the mouthless Rhizopods. And when we add to this, that they are active in their movements and definite in their shape, we have said enough to insure their not being confounded with any of the creatures we have as yet examined. The movements of the ciliated infusoria are exceedingly vivacious; they swim about with great activity, avoiding each other as they pass in their rapid dance, and evidently directing their motions with precision and accuracy. Their instruments of locomotion are of various kinds: some are provided with stiff bristle-like appendages which are moveable, and perform in some measure the office of feet, and with little hooklets serving for attachment to foreign bodies. But the most important locomotive agents are, as has been already stated, the *cilia* with which they are invariably furnished. Their movements never seem to tire. At whatever period of the night they may be examined, they are always found as actively at work as in the day-time; they never sleep.

The cilia are intrusted with another function equally important—viz., the procuration of food: for those situated in the vicinity of the mouth, in which position they are always most evident, produce by their vibration, currents in the surrounding water, which bring to the mouth smaller animalcules, or particles of vegetable matter that may be floating in the neighbourhood, thus insuring an abundant supply of nutriment which, without such assistance, it would be impossible for these living atoms to obtain. The food thus procured is at once swallowed, and accumulates in little pellets in the interior of the semifluid substance of their bodies, giving rise to an appearance

which misled Ehrenberg to suppose that these tiny organisms were possessed of numerous stomachs—hence they were formerly named *Polygastria*,* or many-stomached animalcules.

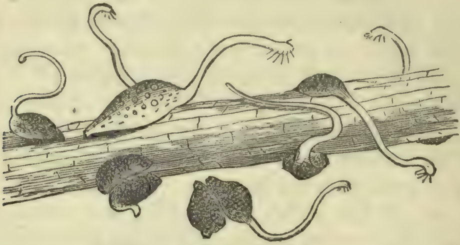

FIG. 13—FIGURE OF SWAN-NECK AND ITS DIVISIONS.

By no means the least remarkable part of the history of the Infusoria is their mode of propagation. This is usually accomplished by the spontaneous division of the adult animalcule into two or more portions, each of which in a short time becomes in every respect a complete individual. We remember in our boyish days hearing of some strange machine for grinding old people young again, and smiled at the idea, little thinking that the conversion of old animals into young ones was, in sober truth, one of the commonest operations of nature. The body of an animalcule about to propagate in this manner, becomes at first slightly elongated, and a line, more transparent than the rest, is seen to cross its middle portion; a constriction next becomes apparent at each extremity of the line indicated, which, becoming more decided and growing gradually deeper, at length divides the animalcule into two halves, only connected with each other by a narrow isthmus, and as this grows thinner and thinner, a slight effort on the part of either of the now nearly distinct portions is sufficient to sever the frail bond of union and complete the separation. In some elongated species

* πολὺς, polus, *many*; γαστὲρ, γαστρὸς, gaster, gastros, *the stomach.*

this fissure is effected in a longitudinal direction, the separation gradually proceeding from the posterior to the anterior portion of the body. Examples of both these modes of increase are delineated in the appended engravings (Figs. 12 and 13).

FIG. 14.—FIGURE OF COLEPS AND CHILOMONAS.

If the organization of these animalcules were as simple as it was supposed to be a few years ago, when they were thought to be mere specks of living jelly imbibing nourishment through all parts of the soft texture of their bodies, this kind of spontaneous division would be a very simple matter, and every step of the process easily understood: a little observation, however, will show that there are circumstances attending this operation of a very inexplicable character. Some species, as for example, *Prorodon teres*,* represented in our engraving (Fig. 12, *b*), are furnished with a very curious mouth surrounded by a cylinder composed of horny teeth, through the agency of which their food is seized and swallowed. Should a deed of separation, therefore, have to be drawn up preparatory to the act of division, it might be a puzzling question for the Infusorial lawyers to settle which half should have the mouth. Even this difficulty has, however, been provided for; and, accordingly, a new mouth and a new dental cylinder is seen to sprout from the hinder half, before the

* *πρώρα*, prora, *fore part*; *ὀδοὺς*, *ὀδόντος*, odous, odontos, *a tooth.*

animal, originally one flesh, proceeds to divorce itself into two.

FIG. 15.—FIGURE OF VORTICELLÆ.

This mode of propagation, in which multiplication and division go hand in hand, is amazingly productive: and, indeed, far surpasses in fertility any other with which we are acquainted. Every schoolboy is familiar with the celebrated problem about the nails in a horse's shoe, or the squares of a chessboard, where the results attainable by duplicative multiplication soon pass ordinary numerical expressions. Let any of our readers try the same problem with one of these animalcules. An individual, if well supplied with food, has been observed to divide at least once in twenty-four hours. So that in a fortnight, allowing the product of each division to multiply at the same rate, sixteen thousand three hundred and eighty-four would be produced from the same stock, and in four weeks two hundred and sixty-eight millions, four hundred and thirty-five thousand four hundred and fifty-six, would be the astounding progeny derived from a single animalcule.

We feel, therefore, but little surprise that with such powers of propagation, these minute creatures soon become diffused in countless myriads through the waters adapted to their habits.

Nor is this all: the reproduction of these prolific animals is sometimes effected in various ways, and not unfrequently the same individual is found to propagate by two or three different modes—thus, many species are multiplied by buds which sprout like those of plants from the surface of their bodies, and speedily attaining the shape of their parent, develop the cilia characteristic of their species.

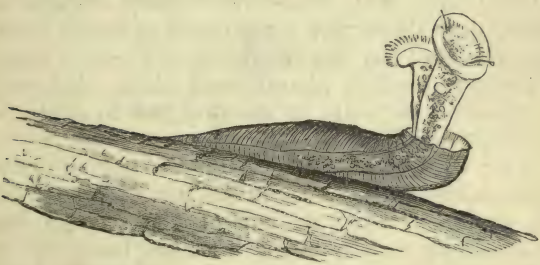

FIG. 16.—FIGURE OF VAGINICOLA.

Neither is it difficult to understand the necessity for such amazing fecundity. These moving atoms are the source from which innumerable animals derive their sustenance, which, in their turn, become the prey of creatures higher in the scale of life; they, therefore, form the basis of that mighty pyramid which bears upon its apex Man himself. They are the boundaries between life and death, the steady barrier of the organic world, and although until a few years ago, man was ignorant of their very existence, they have not the less been actively employed since first creation dawned. As individuals, they are weak enough; but in their countless legions they become, perhaps, the most important agents in the grand economy of nature. A grain of sand is but a de-

spicable atom viewed alone, but when upon the beach these sands present themselves arrayed in their broad phalanx, where can we obtain a stronger bulwark to oppose the raging storm?

CHAPTER V.

Hydrozoa.*

"In the army of Xerxes there was a certain race called Sagartians. The mode of fighting practised by these men was this:—When they engaged an enemy, they threw out a rope with a noose at the end; whatever any one caught, either horse or man, he dragged towards himself, and those that were entangled in the coils he speedily put to death."—Herodotus vii. 85.

Never was there more truth than in the old saying, "there is nothing new under the sun." Who would have supposed, while reading of the strange feats performed by the Brazilian with his lasso, by the aid of which he literally takes the bull by the horns, or trips up the fleetest steed, that the same weapon was used ages ago to catch Greeks by the neck, instead of horses; much less could we have imagined that an onslaught apparently so uncouth and barbarous was the mode of warfare of a very considerable proportion of the animal creation; and yet, seriously speaking, this is the case, the only difference being that the lassos employed by mankind are clumsily made of twisted leather, whereas their prototypes present a delicacy and refinement of structure, which it requires the utmost penetration of the microscope to reveal. There is an animal easily obtainable in summer-time by simply scraping off the slimy surface from the sticks or leaves that float on almost every pond, called

* Hydra, *the Hydra*; ζῶον, zoon, *an animal.*

The **Hydra**,* the history of which is so curious and important, as to demand our special notice. This little creature resembles a small portion of green transparent thread, fastened by one end to the stems of water-plants, while the other is furnished with several radiating filaments of extreme tenuity, which float freely in all directions; should one of the numerous water-fleas, or any other minute animal, come in contact with these floating filaments, though it touch but the tip of one of them, it is at once arrested in its course, and in spite of all its struggles dragged to the central mouth, which opens to receive the helpless prey.

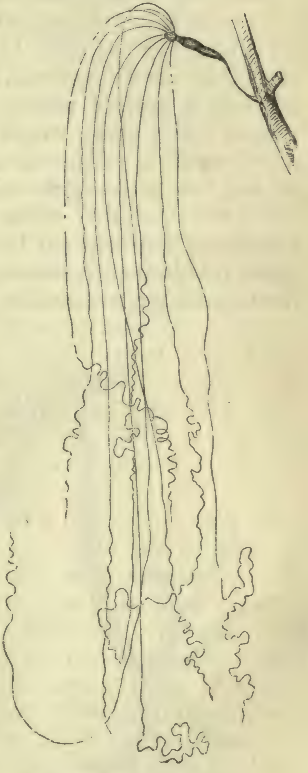
FIG. 17.—LONG-ARMED HYDRA.

The body of the Hydra consists simply of a little gelatinous bag, the margins of which are furnished with filaments employed as tentacles, whilst at the opposite end there is a little sucker whereby it fixes itself to foreign objects. The microscope reveals the substance of these creatures to be composed entirely of a transparent glairy matter, in which granules of slightly greater opacity may be observed to float. Notwithstanding this simplicity of structure, however,

* *Hydra*, a fabled monster that reproduced its heads as fast as they were cut off.

they are able to move from place to place by fixing alternately the extremities of their body after the manner of a leech, and they are sensible to the presence of light, which they always approach.

But their most wonderful attribute is that of being able indefinitely to reproduce any part of their body which may be cut off. If a *Hydra* be cut into pieces, each individual fragment, however small, will speedily become a perfect animal, in all respects like the original, the parts which were defective being produced in their proper situation. If with fine scissors we slit one half-way down, the result will be a Hydra with two mouths, each surrounded by the usual number of tentacles; if these be again and again and again divided, each division will become a new head, thus forming a realization of the fable of the Lernean

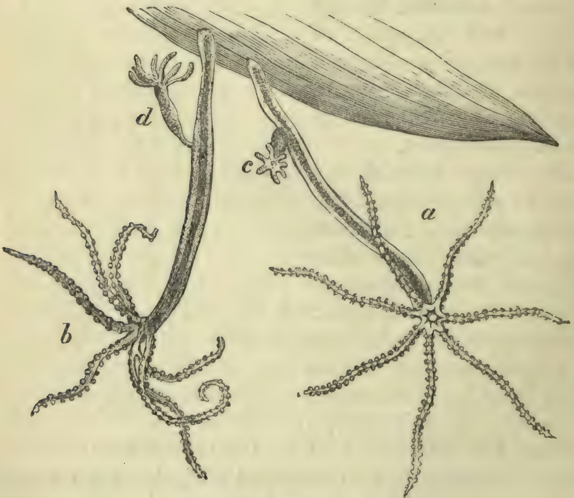

FIG. 18.—HYDRA VIVIDIS.

Hydra. Every one of the tentacles of this newly-formed monster will capture food, and all the mouths will devour it. If two be cut across, and the fore-part of one be applied to the hind part of the other,

the two parts will unite and form a perfect Polype without leaving a scar. They may even be turned inside out like a glove without injury, and in this state will remain, that which was the external surface now being the stomach.

The ordinary mode of increase is by the young animals budding from the side of the adult, but previously to their separation, the offsets themselves often send out side-buds, so that several generations may sometimes be seen branching from one parent; nineteen young of various ages have been seen thus connected, their numerous long tentacles twining about in inextricable confusion.

To the earlier observers of the habits of the Hydræ, nothing could be more mysterious than their power of seizing and retaining active prey; but this is now readily explained. The whole surface of their tentacula is densely provided with a set of organs that appear, under high powers of the microscope, to be minute oval vesicles, something like little soda-water bottles, in each of which is coiled up a long and delicate filament, not unaptly compared to the lasso used by Brazilian horsemen.

The neck of each vesicle is furnished with three sharp spines, which, when the arms are prepared to seize the prey, become erect and prominent. The mode of action of these weapons is as simple as the result is efficacious. The "lasso-threads," with their viscid extremities, speedily involve the seized victim in their tenacious folds, and closely bind it against the spines with which the skin of the Hydra is studded; these, probably, in their turn, become prehensile instruments; and, moreover, apparently form an apparatus of poison fangs of a very deadly character, for it is observable that an animal once seized by the Hydra, even should it escape from its clutches, almost immediately perishes.

We have dwelt at some length upon the history of the Hydra, partly on account of the interest which attaches to an animal so simple in its apparent

structure and yet so formidably armed, but more especially because it is the type of a large class of beautiful creatures, to which we must now beg the attention of the young naturalist.

The Hydræ, as we have seen, are capable of locomotion, and wander about from place to place, but a vast majority of the animals most nearly allied to it in organization in their adult condition are fixed to some foreign object upon which they grow.

The **Club Hydræ (Coryne)*** for example (Fig. 19), are always found growing upon the surface of some shell or stone, to which they seem rooted by the extremity of a

FIG. 19.—CORYNE: *a b*, magnified; *c*, natural size.

horny tube in which they live. In these creatures the upper part of the body is dilated into a kind of club-shaped head, armed with tentacula, which, instead of being arranged in a single circle around the mouth, are distributed irregularly over the exterior in such a manner that, at first sight they seem as though they could be of

* *κορύνη*, korune, *a club*.

little use in procuring food. On watching a living specimen, however, their efficiency is soon rendered manifest. No sooner does a passing animal impinge against one of these filaments than it is seized upon by the lasso-threads, with which they are armed, and held with mortal grasp. The mouth of the Coryne is not a simple orifice, but a protrusible and flexible proboscis, the extremity of which can be directed towards any tentacle whereunto the prey happens to be adherent, and thus the creature feeds itself exactly in the same manner as the hydra described above.

The **Tube Hydra** (*Tubularia*),* constructed very much after the same plan as the preceding, resides in a slender horny tube resembling a straw full of mucilaginous pith, rooted on a solid substance below, and crowned by a living head, resembling a fine scarlet blossom with a double row of tentacula, and often with pendent clusters like grapes. Though perfect as a single stem, it is seldom found solitary, from ten to one hundred and fifty stalks are generally crowded together, and constitute a brilliant group, too gorgeously coloured to be effectively portrayed by art. The tallest specimens rise thirteen inches high, and are generally found on dead shells. The heads, or *Hydræ*, are not retractile into the tube; but, strange to say, are continually falling off, and are replaced. Six have been seen to be thus reproduced, one after the other, in six months. Dwelling among the ravenous inhabitants of the deep, the delicate organs of these defenceless beings are thus subject to continual destruction; but what if they are mutilated, torn asunder, or divided? They again rise unhurt. Wounds or lacerations do not impair the vital principle, and thus abundance is secured—the widow's cruse is constantly replenished.

Fig. 20.—FIGURE OF TUBULARIA INDIVISA.

The **Sea-wreaths** (*Sertulariæ*)† are known to every seaside visitor. In these elegant productions the stem is

* Tubulus, *a little tube.* † Sertula, *a little wreath.*

generally branched into innumerable arborescent forms, so plant-like in their aspect, that when gathered on the beach, they are not unfrequently confounded by our lady-friends, with sundry vegetable growths of kindred appearance, under the name of "sea-weeds;" and sometimes spread by fairy fingers, and laid out in tasteful groups, they seem themselves pathetically to join in the petition so often appended to them by their fair collectors,—

> "O call us not weeds, but flowers of the sea!"

Beautiful, however, as these "sea-weeds" are when thus embalmed, we, for our part, prefer to see them living in their native element, where they present a spectacle of matchless interest, viewed even with an ordinary microscope. When thus examined, they are found to be made up of branching tubes, along the sides of which are ranged in close array little cells or cups sometimes many thousands in number. Each cell contains a hungry hydra, with its arms spread out in search of food, ready to seize and drag into its mouth whatever offers in the way of aliment. These Polype-cells are variously disposed

FIG. 21.—FIGURE OF SERTULARIA OPERCULATA.

in different species, but they all agree in being *sessile*, that is, closely sitting on the branchlet where they grow. Dispersed among these cells, at certain periods of the year, others are seen of different shape; these are the seed-cups, one of which is represented in our figure. In

these elegant vases are formed the germs of their innumerable progeny, which, when mature, swim forth like little bands of jelly (*planulæ*) covered externally with countless *cilia*, enabling them to roam at large in the surrounding water, till they meet with a fit resting-place whereon to settle down, and found another colony as wonderful as that from which they sprung.

Closely resembling the sea-wreaths—so much so, indeed, that they might be easily be mistaken the one for the other—are

The **Bell Corallines** (*Campanularia*),* a specimen of which is represented in the appended figure (Fig. 22). There are, however, important differences between the two families, which it will be necessary to explain. In the Sertularians, as we pointed out, the Polype-cells are *sessile*, closely sitting on the stem. In the *Campanularians* every Polype-cup is raised on a small stalk or pedicle, so as to resemble very closely a little wine-glass, the horny stem being ringed at intervals, thus giving a certain flexibility to all the branchlets. The little vases, where the young are formed, are always found to sprout just from the angle where the Polype-cells join to the central stem, and are much larger and of different shape. The most important difference, however, is, that in this family the young, instead of being ciliated germs (*planulæ*), are active organisms, so unlike their parents, as to be quite unrecognisable as belonging to the same stock; insomuch, indeed, that before describing them, it will be necessary to make the student acquainted with another series of beautiful creatures that await our notice.

FIG. 22.—FIGURE OF LAOMEDEA.

Acalephæ.†—The ocean in every climate swarms

* Campanula, *a little bell.* † ἀκαλήφη, akalephe, *a nettle.*

with infinite multitudes of animals, which, from their minuteness and transparency, are almost as imperceptible as the infusoria themselves. All, however, are not equally minute, some grow to a large size, and various forms of these are familiar to the inhabitants of every beach, upon which, when cast up by the waves, they lie, like masses of jelly, melting, as it were, in the sun, exhibiting but few traces of that elaborate structure, which more careful examination discovers them to possess. Their uncouth appearance has gained for them various appellations by which they are generally known, as *Sea-jelly*, *Sea-blubber*, or *Jelly-fishes;* whilst, from disagreeable

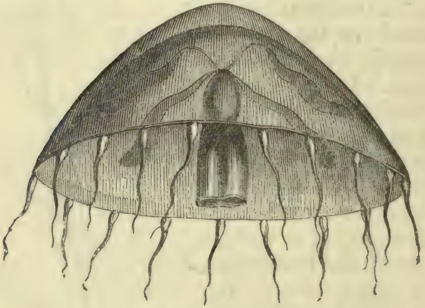

FIG. 23.—SEA-BLUBBER.

sensations produced by handling most of them, they have been called *Sea-nettles*, *Stingers*, or *Stangers*. Their faculty of stinging is, indeed, the most prominent feature they exhibit, so that their names in almost all languages are derived from this circumstance. They were known to the older naturalists by the title of *Urticæ Marinæ*, and the scientific appellation, whereby they are generally designated, is of similar import. The forms of these gelatinous creatures cannot well be distinguished when thus cast up by the waves; but if we look over the side of a ship at anchor, or take an excursion in a boat, we shall see many floating freely in their own element, and displaying all the elegance and beauty of

their structure. The species most commonly met with assume the form of a mushroom, or umbrella-shaped disk, composed of transparent jelly. They move by alternately expanding and contracting their bodies, and swim with their upper surface directed forwards, while their fringes and tentacles follow behind, "like streamers long and gay."

The **Long-tailed Stinger** (*Cyanea* capillata*) of our seas is a most formidable creature, and the terror of tender-skinned bathers. With its broad, tawny, festooned and scalloped disk, often a full foot or even more across, it flaps its way through the yielding waters, and drags after it a long train of riband-like arms, and seemingly interminable tails, marking its course, when the body is far away from us. Once tangled in its trailing "hair," the unfortunate, who has recklessly ventured across the monster's path, soon writhes in prickly torture. Every struggle but binds the poisonous threads more firmly round his body, and then there is no escape, for when the winder of the fatal net finds his course impeded by the terrified human wrestling in his coils, seeking no combat with the mightier biped, he casts loose his envenomed arms, and swims away. The amputated weapons, severed from their parent body, vent vengeance on the cause of their destruction, and sting as fiercely as if their original proprietor gave the word of attack.—PROF. FORBES.

The **Tube-mouthed Sarsia** (*Sarsia† tubulosa*) (Fig. 24), is a species of smaller dimensions, which, as it floats gracefully along, might be supposed, sylph-like, to live on light, and quaff the ether, but is in reality by no means addicted to such scanty diet. A few of them being kept by Professor Forbes in a jar of salt water, in which were some small shrimps, devoured these animals, so much more highly organized than themselves, voraciously, apparently enjoying the destruction of the upper classes with a truly democratic relish. One of them even attacked, and commenced swallowing, a medusa, quite as good as itself. An animal that can pout out its mouth to twice the length of its body, and stretch its stomach to proportionate dimensions, must, indeed, be a triton among the minnows,

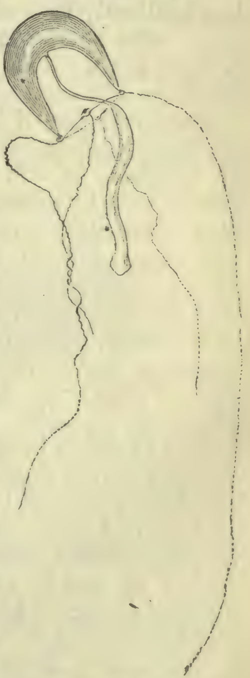

FIG. 24.—FIGURE OF SARSIA.

* κυάνεος, kuaneos, *dark*. † Sars, *a proper name.*

and a very terrific one too. Yet is this ferocious creature one of the most delicate inhabitants of the ocean, and a very model of tenderness and elegance.—PROF. FORBES.

In many species, as in that represented in Fig. 25, the margin of the transparent disk is fringed with short and slender tentacles, each of which springs from a fleshy bulb, wherein is set a speck of deep purple colour, thought to be an eye, giving an appearance as though the body was surrounded with a circlet of gems. On taking it into a dark room and striking the glass, every purple eye becomes lighted into a phosphoric flame, and again and again the crown of light may be made to flash forth, but less brilliantly than at first, until at length each tiny lamp, after sparkling for a moment, wanes, and all is dark again; and at last it refuses to shine any more.

These bell-shaped Acalephs are exceedingly prolific. Their usual mode of increase, as will be explained further on, is by means of eggs, or ciliated gemmules; nevertheless, there are some of them which, like the Hydra, are propagated by offshoots that spring as buds from various parts of the body, with which they remain connected like branches issuing from a plant. "Fancy," says Professor Forbes, "an elephant with a number of little elephants sprouting from his shoulders, bunches of tusked monsters hanging, epaulette-fashion, from his flanks, in every stage of advancement. On his right shoulder, a youthful chuny, with head, trunk, toes, no legs, and a shapeless body; on the left, an infant elephant, better grown, and struggling to get away, but as yet fast by the tail, and incapable of liberty and free action. The comparison may seem grotesque and absurd, but it really expresses what continually occurs among these Medusæ.* It is true that the

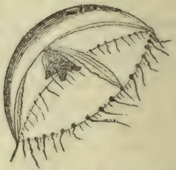

FIG. 25.—FIGURE OF THAUMANTIAS.

* The Acalephs are frequently called "*Medusæ*," their stinging appendages being compared to the snakes on Medusa's head.

latter are minute; but wonders are not the less wonderful for being packed in a small compass. A whale is not above a minnow for his mere bigness."

It was, doubtless, a brave attempt of the adventurer who first dared to trust himself in a boat upon the surface of the ocean, neither is it difficult to imagine the trembling confidence with which he framed his rude bark, and hoisted the rough sail of mat or canvas to the favouring breeze, following the course of some great river, the Euphrates or the Tigris, till he reached the sea, vaunting himself upon his ingenuity; and yet, to his astonishment, he must have found, dancing before him on the sun-lit wave, a boat, far more beautiful than that he had contrived, with mast, and sail, and ballast, all complete.

The **Sallee-man** (*Velella* scaphoidea*), as it is prettily named in Latin, consists of a transparent disk of purest jelly, supported by a delicate plate of firmer texture, lodged in its interior; upon its upper surface there is raised a mast, a thin, broad film of cartilage, on which is spread a sail, worthy to waft along a fairy queen; while

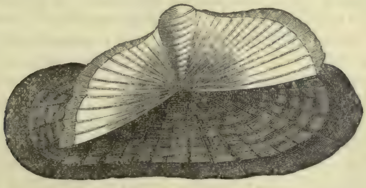

FIG. 26.—VELELLA.

from beneath hang polype-like appendages that fish for food. To perfect so beautiful a contrivance, in *Rataria*, a kindred species, the crest, is found to contain fibrous threads, apparently of a muscular nature, by the contractions of which the sail can be lowered or elevated at the pleasure of the little mariner.

Perhaps there are few animals more beautiful than

The **Globe Beroe** (*Cydippe*† *Pileus*) (Fig. 27); if placed in a glass of clear sea-water, it looks like a sphere of the purest ice, from which can be protruded two long tentacles, each of which is furnished along one side with a series of spirally-twisting filaments. Stretching from

* Velella, *a little sail;* scaphoidea, *like a boat.*
† Cydippe, *the name of a goddess.*

pole to pole of this translucent little orb, like lines of longitude upon a globe, and placed at equal distances, are eight broad bands of more consistence than the other portion of the body. On each of these

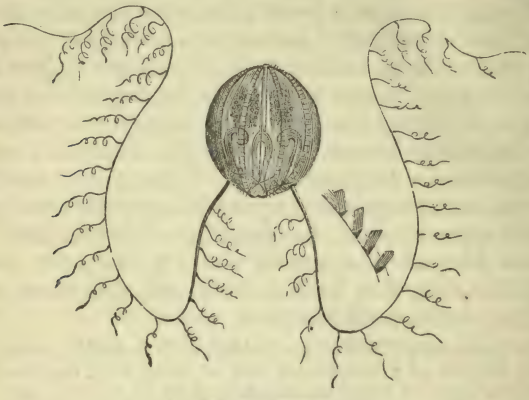

FIG. 27.—CYDIPPE.

bands are placed thirty or forty paddles, exactly comparable in their shape to the floats upon the paddle-wheels of a steamboat; and in like manner by means of these the little creature rows itself along. Man to move his wheels must have much cumbersome machinery—the furnace, and the boiler, and the herculean arm, that makes the enginery revolve. Nature wants none of these encumbrances; her paddles are themselves alive, and move at will with such degree of force as may be needed, either at once or singly, or in groups, working with mutual consent in any way required. Thus do they all row equally; the little Beroe shoots meteor-like along, or if a few relax their energy, wheels round in broad gyrations, or revolves upon its axis with inimitable ease and grace.

Neither are nature's steamboats left without the means of anchoring. Whoever has been on board one of our sea-going leviathans must have been surprised to see the massive anchors and the tons of rope or iron cable coiled up in the hold, the labouring capstan and the mighty gear required to run them out or heave them up. With all this cumbrous load nature dispenses. The Beroe, when it chooses, can put forth from one end of its body what appear like filaments of molten glass, which, as we watch them, lengthen, as it were by magic, and from their sides unfold transparent tendrils, like the tendrils of a

vine, which twining round some foreign object, hold the little bark secure. When no longer wanted, shrinking back into itself, this apparatus vanishes from view, leaving no trace of its existence.

Minuter forms of these Beroes throng the icy seas in countless myriads, and their abundance and exceeding beauty have attracted the attention of all northern voyagers. Great shoals of them are there met with, discolouring the water for a vast extent. Scoresby observed, that the colour of the Greenland sea varies from ultramarine blue to olive green, and from the purest transparency to striking opacity, appearances which are not transitory but permanent. The green semi-opaque water mainly owes its singular aspect to minute Beroes and Infusorial animalcules. It is calculated to form one-fourth part of the Greenland seas, between the parallels 74° and 80°. It is liable to alterations in its position, from the action of currents, but it is always renewed near certain situations from year to year. The whales

FIG. 28.—FOOD OF THE WHALE:
, *Limacina helicina*; 2, 3, 4, *Medusæ*; 5, *Clio borealis*.

throng in this opaque water, for to them it is a good wholesome soup, nourishing enough, as may be judged from the following curious calculation:—"The number of Medusæ," writes Mr. Scoresby, "in the olive green water was found to be immense. They were about one-fourth of an inch asunder. In this proportion a cubic inch of water must contain 64;

a cubic foot, 110,592; a cubic fathom, 23,887,872, and a cubical mile about 23,888,000,000,000,000! From soundings made in the situation where these animals were found, it is probable that the sea is upwards of a mile in depth; but whether these substances occupy the whole depth is uncertain. Provided, however, the depth to which they extend be but two hundred and fifty fathoms, the above immense number of one species may occur in a space two miles square. It may give a better conception of the amount of Medusæ in this extent, if we calculate the length of time that would be requisite with a certain number of persons for counting this number. Allowing that one person could count a million in seven days, which is barely possible, it would have required that eighty thousand persons should have started at the creation of the world to complete the enumeration at the present time."

The Medusæ in question were Beroes, called "*Fountain-fishes*" by the earlier voyagers to Spitzbergen, who, mistaking the cause of the eight bands of iridescence gleaming along the sides of their bodies, fancied they were so many rivulets of lustrous water.

In a third form of these beautiful creatures, hence denominated

Hydrostatic Acalephæ, the animal is supported in the water by a very peculiar organ, or set of organs, consisting of one or more bladders filled with air, which are appended to the body in various positions, so as to act as floats of sufficient buoyancy to sustain the creature upon the surface of the sea.

The **Physalia*** (Fig. 29), known to sailors by the name of the *Portuguese man-of-war*, has this swimming apparatus single and of great proportionate size, so that when full of air it is exceedingly buoyant, and floats conspicuously upon the waves. It closely resembles, when seen from the deck of a vessel, a child's mimic ship with its sails set; and excites the wonder of those who behold it, to see so delicate and frail a bark breasting the billows, as it seems that the first breaking sea must inevitably overwhelm and dash it to pieces. Yet there it floats, and dances now on the curling

* φυσαλίς, phusalis, *a bladder*.

crest, now in the deep hollow, in spite of wind and wave. Often while passing just under the lee of the vessel, the sudden lull made by the interposition of so great a body between it and the wind, will cause it for a moment to lie flat on the water; but it instantly resumes its upright position. When examined closely, the animal is seen to consist of an oblong transparent bladder, surmounted by a kind of crumpled crest of a delicate pink colour. From one end of the bottom of this bladder proceeds a large bunch of appendages of various shapes, which trail in the surrounding water. These hanging tentacles are of a very beautiful colour, and possess the power of stinging in a formidable degree.—MR. GOSSE.

FIG. 29.—PHYSALIS.

The long cables, or tentacula, can be thrown out to a great distance, to twelve or even eighteen feet, and by the aid of these the Physaliæ are able to capture any small fishes that may come in their reach; and which, by the wonderful retractile power of these appendages, are speedily conveyed to the short suckers or mouths, whereby the prey is devoured. On placing the Physalia in a tub of water with some little fishes, they were immediately entangled in its grasp, and the tubes were soon seen to be filled with portions of the fish sucked into their interior. It is a very interesting sight to watch one of these animals thus placed in a large tub of water, sometimes coiling up its tentacles to within half an inch of their bladder-like support, and then darting them out with surprising velocity to the distance of several feet, entwining and benumbing their prey, and then dragging it towards their polype-like mouths.—DR. BENNETT.

And now, reverting to the animals described in the few last pages, so diverse in their forms, and in their attributes, the reader perhaps begins to wonder what relationship exists among them that they should thus be classified as members of the same great family; and this we must next proceed to explain.

Any one who will examine, with a little industry, the surface of the stones, or shells, or rocks, upon the shore, just at the lowest point of the ebb-tide, will probably observe, clinging to their surface, numerous

delicate white tufts or tassels, every one of which, examined closely, is found to be a *hydra*, scarcely different in its form or habits from that we have described in a preceding page.

This marine hydra has received the name of *Hydra tuba:* it quite equals in voracity its fresh-water namesake, is equally formidable in its armature of lasso-threads, and is ordinarily multiplied in the same manner by buds or gemmæ that sprout from its surface: at certain seasons, however, the body of the Hydra tuba becomes considerably elongated, and divided by constrictions into numerous segments, resembling a pile of saucers placed one within the other. Shortly, from the margin of each saucer, tentacles are seen to sprout, not resembling those of the hydra, but those of the medusæ, and

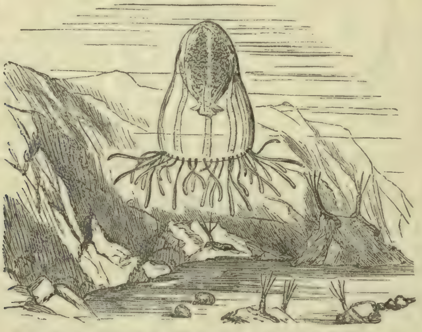

FIG. 30.—FIGURE OF TURRIS AND ITS YOUNG.

after a little while these saucers, detaching themselves successively from the top of the pile, swim away completely formed and active Acalephæ (Fig. 30).

The *Campulanarian Zoophytes* (Fig. 22), as we have explained, produce their young in elegant transparent vases, which sprout from the bases of their Polype-bearing branchlets, yet when these vases open they send forth, not ciliated embryos, as is the case with the Sertularian Polypes (Fig. 21), but

Acalephs, that swim about like little parachutes, cast out by thousands into the surrounding water. On the other hand, the young of the medusæ are found, in the first stage of their existence, exactly to resemble hydriform Polypes, proving at least the existence of a relationship among them, although its extent is as yet very imperfectly understood.

CHAPTER VI.

ANTHOZOA* (*Corals*).

If earth can boast its gardens and parterres, so can the bottom of the sea; nor do the flowers of ocean yield one jot either in the elegance of their forms, or the brilliancy of their colouring, to the blossoms that adorn the realms of Flora. The corallines that we have hitherto considered, constitute, as it were, but the mosses and the lichens of the coral landscape: we must now turn our attention to the larger plants and shrubs. The **Zoophytes,**† that next present themselves to our consideration, imitate nearly every variety of terrestrial vegetation. Trees of coral exist, which, though they do not equal in size the oaks of our forests, are gracefully branched, and their whole surface blooms with coral-polypes in the place of leaves and flowers. Our shrubs, our rose-trees, beds of pinks and feathery ferns are all reflected, as it were, in mimic beauty. Some species spread themselves into broad leaves, studded with Polype flowers. The gorgeous blossoms of the cactus, the full-blown sun-flower, and the wreathing vine, have each their living representatives. Besides these forms, imitating vegetation, the shapes of graceful

* ἄνθος, anthos, *a flower;* ζῶον, zoon, *an animal,* so called from their resemblance to flowers.

† ζῶον, zoon, *an animal;* φυτόν, phuton, *a plant;*—thus named by the older naturalists from their plant-like appearance.

vases rear themselves amid the fairy scene, festooned with coral branchlets, and there are solid hemispheres resembling domes bedecked with Polype stars of purple and of emerald green, huge fans expand on every side, and Madrepores are crowded round in turfy clumps to variegate the prospect. Words,

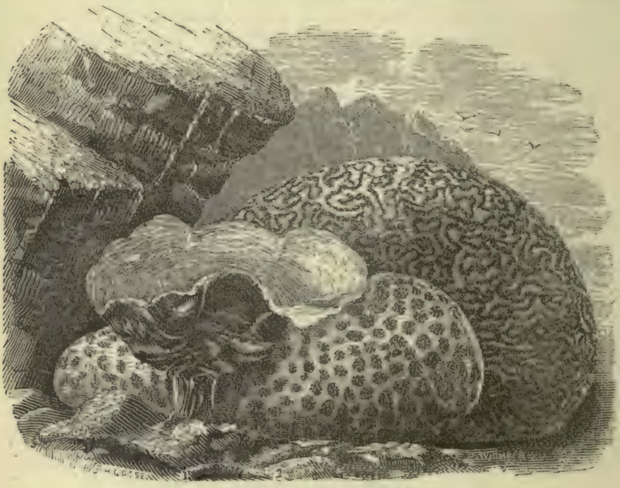

FIG. 31.—MADREPORES.

however extravagant they may appear, can convey no exaggerated impression of such a scene, for fancy's work could never be more strangely beautiful. It is not, however, in their luxuriance of growth that we must introduce the **Anthozoa** to the contemplation of the student; we must select a few among the multitude for special study.

The **Alcyons** (*Alcyonium*).—Every stroller upon the beach must frequently have found, cast up by the retiring waves, rude shapeless lumps of leathery consistence, known by the vulgar as *Cow's paps* or *Dead man's fingers*, names which, however characteristic, are by no means calculated to invite attention. Nevertheless, on placing one of these misshapen masses in a jar of clear sea-water, it will soon present a spectacle that must command our

admiration. Slowly the unsightly fabric swells, as though by imbibing the water in which it is immersed, and as it dilates to a larger and still larger size, assumes a transparency that it did not possess before. When fully expanded, little pits or cells appear upon its surface, and from each of these there issues forth a living flower, for

Fig. 32.—Alcyon.

such it seems, which gradually expanding till it has attained its full development, begins to fish for prey in the surrounding water by means of the petal-like tentacles placed around its mouth. The food thus obtained, having been conveyed into the stomach of the Polype that caught it, and digested there, is absorbed into the

general mass of the Alcyon, which in this way derives its nourishment from the numerous sources of supply distributed over its surface.

FIG. 33.—FIGURE OF POLYPES OF ALCYON.

The Polypes that are thus protruded will be found, on examination, to differ very materially in their structure from the Hydræ described in the preceding chapter. In the **Anthozoa** the Polypes, when expanded, are found to have eight hollow tentacles, the margins of which are fringed by a triple row of minute fleshy papillæ.

These tentacles surround a central orifice, which is the mouth. Internally, we may perceive that each Polype is furnished with a distinct stomach, suspended in the centre of its body, not simply excavated in the gelatinous substance. The space between this stomach and the walls of the Polype is divided into compartments by membranous partitions, whereby the stomach is suspended and retained in its position. These differences of structure, which are sufficiently evident, at once enable us to distinguish the **Hydrozoa** from the **Anthozoic Zoophytes.**

Madrepores.—It is evident that the Alcyons described above must necessarily be of very limited dimensions, else from the general softness of their bodies, they would be overwhelmed by their own weight. If, therefore, animals of similar organization

are required constructed upon a larger scale, it becomes needful that the whole fabric should be supported upon some internal framework or scaffolding, of a nature sufficiently firm and unyielding to sustain the general body, and thus allow full room for the expansion of the flower-like Polypes. In a vast majority of instances, therefore, the common substance of these creatures has the power of depositing earthy particles derived from the surrounding water, wherewith it builds a massive skeleton, presenting upon its surface innumerable little pits or cells wherein the Polypes lodge. Such are

The **Madrepores**, whose skeletons form the ornaments of our cabinets, and of which a small fragment is delineated in the accompanying engraving (Fig. 34).

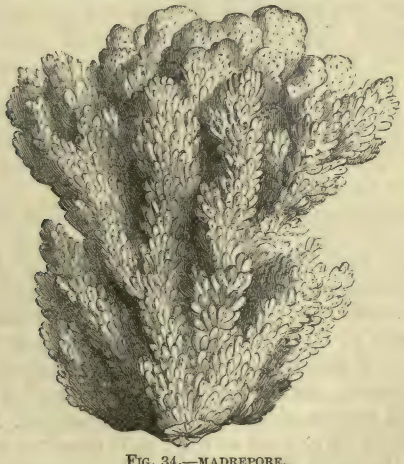

FIG. 34.—MADREPORE.

Many of these stony masses form branching clusters of exceeding elegance, nor is our admiration at all abated when we institute a closer examination of their structure. Take any one of all the million cells which crowd its surface, each tiny orifice in which each individual Polype of the countless host resides is in itself a microscopic gem, matchless for the regularity and beauty of its arrangement, and the mathematical precision with which it

is built (Fig. 35). During the life of the Madrepore, every one of these minute cells gave issue or concealment

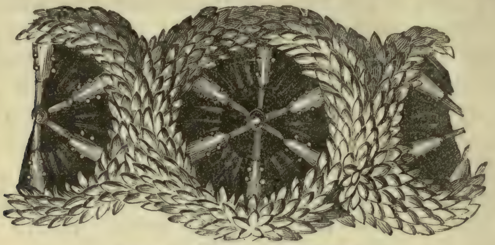

FIG. 35.—ORIFICE OF MADREPORE.

to a radiant Polype, which, like a living flower, protruded its eight arms in search of food.

In the hot climates where these stone-making corals abound, they frequent shallow bays and sheltered spots, where they can enjoy the full influences of light and are unexposed to the agitation of the ocean: in such situations the submarine rocks become gradually incrusted with their calcareous skeletons, and if left undisturbed, in the lapse of years successive generations deposit such large quantities of calcareous matter as to form beds of considerable thickness.

In the formation of their massive skeletons, it must be remembered that life and death constantly keep pace with each other. The living mass, whilst growing at the top, is with concurrent progress perishing beneath, leaving the imperishable stone a still accumulating mound. With such a mode of increase, there is no necessary limit to the growth of these zoophytes. The rising mass may expand upwards, until it nears the surface of the sea, when death ensues simply from exposure, and not from any failure in its powers of life; still growing round the margin of the rock itself has formed, it spreads on every side. Old ocean raves to see a whole domain thus rescued from his grasp, and piles upon the nascent island mud and weeds, which soon produce a vegetable soil; seeds brought by birds, and cocoa-palms take root upon the new-born surface, soon thick groves appear, inviting human occupation, and man comes at last to take possession of a territory reared by the unaided efforts of these humble creatures.

Could we raise one of these islands from the sea, we should find the coral reefs surrounding it like magnificent piles of artificial masonry resembling ramparts, perhaps, a hundred miles or more in circuit.

Mr. Darwin has estimated the reefs of the Gambier group at their outer limits to be two thousand feet in thickness. Some of the coral beds in the Pacific Ocean have a length of twelve hundred and a breadth of three hundred and fifty or four hundred miles, while another on the Australian coast is at least twelve hundred miles long. Thus, therefore, at the bottom of the sea we find materials plentiful enough wherewith to build, not islands only, but whole continents, which only want upheaving to the surface to become the abode of Man; and there is an agency at hand whereby they can be raised. He who has climbed Vesuvius, or scaled the lofty sides of thundering Etna, has had proof enough that there is fire beneath the ground he treads upon; and that this fire is widely spread, a single glance at any map will testify. Through Europe, Asia, and the mighty chain,

> "Where Andes, giant of the western star,
> With meteor standard to the winds unfurl'd,
> Looks from his throne of clouds o'er half the world,"

each mountain tells us of volcanic power imprisoned deep beneath its basis. Suppose, for a moment, that through some wide rent the ocean found its way into this fiery gulph, and the imprisoned steam, produced by such a dread catastrophe, putting its Titan shoulders to the roof, heaved up the bottom of the sea, with all its coral load; mountains huge would raise

> "Their broad, bare backs into the sky,"

from which new rivers would descend to fertilize another region of the globe.

The **Corals** (*Corallium*)* properly so-called (Fig. 36), have their central axis, which supports the external living flesh, solid, without cells for the lodgment of the Polypes,

* Corallum, *coral.*

and variously branched. As a well-known example of this tribe of zoophytes, we may select for description the common red coral (*Corallium rubrum*), a branch of which is represented in our figure. The red coral is principally

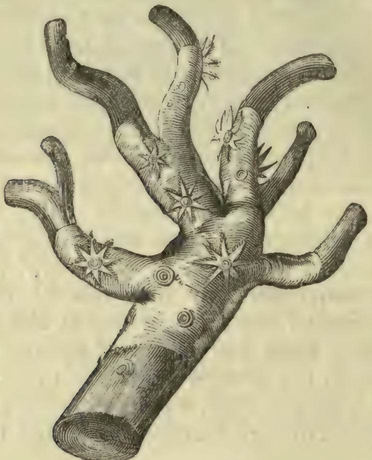

FIG. 36.—RED CORAL.

obtained from the Mediterranean: when growing at the bottom of the sea, it consists of short branched stems incrusted with the living flesh, whereby the central axis is produced, and which at intervals is studded with the flower-like mouths that give it nourishment. The central stem or "polypary," as the stony axis is called, is of extreme hardness, and susceptible of a high polish, to which circumstance, together with its brilliant crimson hue, the estimation in which it is held is principally owing. The fishery for coral is carried on in boats. Each boat contains at least three men, who are provided with a massive wooden cross, to whose equal arms are attached strong hempen nets. A large stone placed upon the centre of the apparatus sinks it to the bottom, frequently to the depth of two hundred or three hundred feet. While one of the fishermen is employed in alternately raising and letting fall the machine, bumping the ground to break the coral stems, the others row the boat, so as to sweep over a certain space. After a time the

whole is drawn up, and the fragments of coral which have been retained by the meshes of the net, are carefully removed.

The **Mare's-tail Coral** (*Isis* Hippuris*). The short and stunted trunks of the red coral, which in their shape resemble little oaks, although composed of brittle substances, are strong enough to resist the violence of the tempest; but in the taller and more slender forms, such brittleness would render them quite unfit to occupy the situations in which they grow, and they would be continually liable to be broken by the agitation of the sea, if, by a beautiful modification in the construction of their central stem, they had not been adapted to the circumstances of their position. In the Isis Hippuris, therefore (Fig. 37), the central axis is constructed with alternate

FIG. 37.—ISIS.

joints of stony and of horny substance; so that, being thus made flexible, they bend before the passing waves, and thus remain secure from otherwise inevitable destruction.

The **Bark-bearing Corals** (*Gorgoniae*)† in their length and slender form resemble osiers, or, as in the case of the *Gorgonia flabellum* (Fig. 38, 1), are spread out into large flat expansions that are called sea-fans. These zoophytes

* Isis, *a goddess;* ἵππος, hippos, *a horse;* οὐρά, oura, *a tail* (*Mare's-tail,* a plant).

† Gorgon, *a mythological name.*

have their framework entirely composed of horny substance, which is black, and coated with flesh of a bright yellow colour, or sometimes purple. From the ramifications being very numerous and uniting with each other at short intervals, this species is a very beautiful one; and when bespangled with its living flowers, presents a charming spectacle.

The **Sea-pens** (*Pennatulæ*) * (Fig. 38, 2) constitute a very remarkable family, specimens of which are frequently brought up in the nets of fishermen upon our own coasts. The species represented in our engraving (*Pennatula phosphorea*) very closely resembles a broad feather from two to four inches in length, and of a purplish colour, the lower part, which represents the barrel of the quill, is tipped with orange. Above this the stem is fringed on each side with flat appendages that represent the plume, along the upper edge of which are placed the cells wherein the Polypes lodge. Some authors have affirmed that the Sea-pen swims freely in the sea; but modern observation tends to throw discredit on this statement.

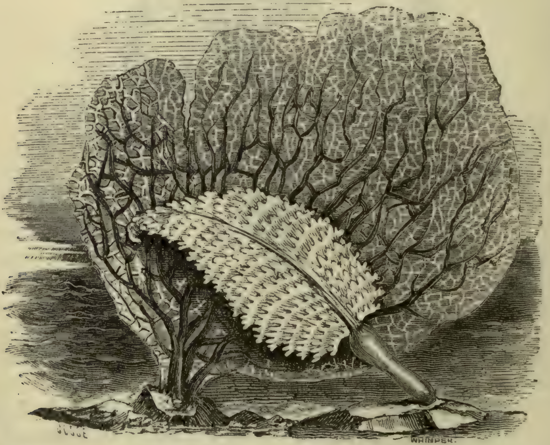

FIG. 38.—1. SEA-FAN. 2. SEA-PEN.

It is usually found with its stem inserted into the mud at the bottom, and those that have been kept for observation

* Pennatula, *a little feather.*

have never exhibited any capability of locomotion. Some species, when disturbed, become highly luminous, insomuch, that the statement of Linnæus, that the "phosphorescent *Sea-pens* cover the bottom of the sea, and there cast so strong a light that it is easy to count the fishes and worms sporting among them," is by no means devoid of foundation.

Hitherto we have seen the solid part either stony or horny, called the skeleton or *polypidom*, deposited within the living flesh, but there are some species of Anthozoa in which it forms a protecting sheath to the bodies of the Polypes which are lodged in its interior. The elegant aggregation of tubes called

The **Organ-pipe Coral** (*Tubipora* Musica*) is an example of such a structure (Fig. 39). It consists of small cylindrical tubes of a rich crimson hue, placed nearly parallel, but at a short distance apart, and united at regular distances by successive stages of horizontal plates, that divide the series into ranges, or stories, like the

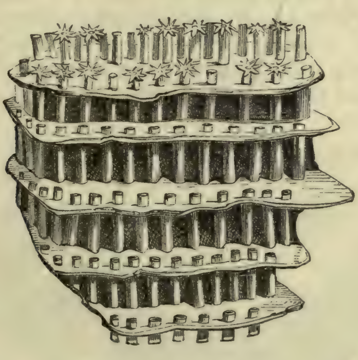

FIG. 39.—ORGAN-PIPE CORAL.

different floors of a house supported by many pillars. From the mouth of each tube, in the living state, protrude the eight tentacles of a starry Polype of a brilliant green colour, forming a striking contrast with the crimson polypidom.

Actiniæ.†—In the succeeding group of Polypes, while the general form and structure of the Anthozoa are preserved, we find an organization much more complex than

* Tubus, *a tube;* porus, *a pore.*
† ἀκτὶν, aktin, *a ray.*

we have yet encountered. In the *Actiniœ* the tentacles are very numerous, and ranged in several circles round the mouth. When expanded, being often of gay colours, they so much resemble composite flowers, such as the daisy, the marigold, and others, as to have obtained their names for different species, and the term "animal flowers" for the entire group. When expanded and viewed in profile, the form of an Actinia is that of a short, broad, cylinder, with the tentacles radiating from the upper margin (Fig. 40), the base being somewhat dilated. But when the absence of light or water, or any other cause, induces them to repose, the tentacles contract, and the upper part of the body, by a partial inversion, closes over them, leaving no trace of the place where they disappeared except a wrinkled depression in the centre. In this condition their shape is, more or less, that of a bell, as may be seen in the next figure (Fig. 40).

When still more firmly closed, the creature looks like nothing but a rounded lump of fleshy substance, plastered on the rock (Fig. 41, 2); but as the animal again expands, the central opening at the top gradually widens, the margin slowly rolls back, and the tentacles it concealed begin to show their tips. As the expansion goes on, the

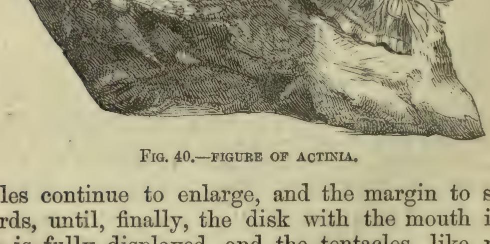

Fig. 40.—FIGURE OF ACTINIA.

tentacles continue to enlarge, and the margin to spread outwards, until, finally, the disk with the mouth in the centre is fully displayed, and the tentacles, like petals, fringe it round.

In the species delineated in the next figure, *Actinia gemmacea*, there is an instinct displayed of a very admirable character. Such

individuals as have taken up their residence on the half-submerged rocks, where the daily recess of the tide exposes them to observation, are covered with rough warts, and blotched with dusky brown, and dull orange; and still further to insure their concealment, cover themselves with fragments of shells, seaweed, and gravel, which adhere to their skin so strongly as not to be washed off; and being thus veiled, the animals are quite concealed from observation. On the other hand, those species which inhabit deep water, as if aware that the necessity for concealment no longer existed, use no such precaution: their skins are smooth and naked, and adorned with the vivid tints which make the species so beautiful. These Actiniæ are easily procured, and may be kept alive in sea water for a long time without difficulty: in a glass vessel their beauty is displayed to advantage. They are capable of very long fasts, although sufficiently voracious when food is to be obtained.

Although the Actiniæ are usually fixed to the bottom by their broadly-expanded bases, many of them can detach themselves, and float through the water to a new resting-place; or they will slide along slowly over the rocks, by the action of their base or foot, and some are said to turn themselves over and walk upon the extremities of their tentacles. There is, indeed, a small group of Actiniæ (*Actineta*) fitted expressly for an ocean life, by means of an air-cavity in the base containing a vesicular or spongy disk made up of air-cells, which serves as a float. Thus provided, the animal lies on the water with its base uppermost and its mouth and tentacles below the surface, and in this position it is carried about by winds and currents.

The tentacles of the Actiniæ are not always simple tubes: in the *A. alcyonoides*, represented on the left hand of our engraving (Fig. 41, 1), they are of a very complex character, and are provided near their tips and at their sides with minute suckers, with which they are enabled to grasp their prey.

In common with the Hydrozoa the Actiniæ are furnished with an armature of oblong, transparent vesicles, which have the power of shooting out a long thread-like lasso of excessive tenuity. These abound on the tentacles; but there are also certain special organs upon which they are crowded to an extraordinary degree, and which seem to be simply

magazines of these weapons. Certain species of Actiniæ have the faculty of shooting forth from orifices scattered over the surface of the body, slender white filaments in great profusion, coiled up so as to resemble tangles of sewing cotton. The slightest touch is sometimes sufficient to make these filaments shoot forth from various points with great force and rapidity. They have a strongly-adhesive power, which is dependent upon a very wonderful mechanism. On being examined with a microscope,

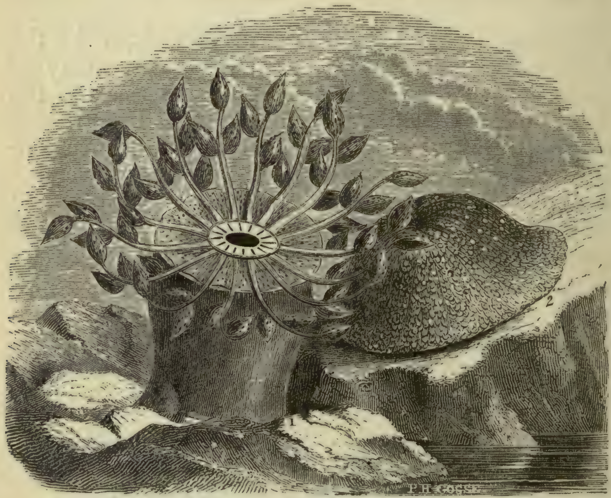

FIG. 41.—ANIMAL FLOWERS; 1, *Actinia Alcyonoides*; 2, *A. Gemmacea.*

the entire surface of the tentacula and the cotton-like threads are seen to be densely crowded with transparent oval vesicles, in each of which is coiled up a delicate filament, often thirty or forty times longer than the capsule which contains it, and moreover this lasso-thread is variously armed with sharp barbed spines of inconceivable minuteness, but formidably effective for their purpose. On the slightest irritation, the spiral-thread bursts forth and entwines the victim in its spiny folds, which seem to be armed

with some potent venom, as a small animal once seized by them dies, even should it escape from their tenacious grasp.

The Actiniæ, like the Hydra, seem to defy the effects of mutilation; they may be cut in two perpendicularly or across, and each cutting will soon furnish forth the wanting parts, and present itself in all respects well and hearty.—Mr. GOSSE.

In some species, when a large individual has been a good while adherent to one spot, and at length chooses to change its quarters, it does so by causing its base to move slowly along the surface on which it rests. But it frequently happens that small irregular fragments of the edge of the base are left behind, as if their adhesion had been so strong that the animal found it easier to tear its own tissues apart than to overcome it. The fragments so left soon contract, become smooth and spherical, or oval in outline; and in the course of a week or a fortnight, may be seen each furnished with a margin of tentacles, and a disk, transformed in fact into perfect though small Actiniæ. Occasionally a separated piece, more irregularly jagged than usual, will, in contracting, form two smaller fragments, each of which becomes a separate animal. Dr. T. Strethill Wright cut off a minute piece of the base of a Sea Anemone; the part immediately receded from the parent, and in three weeks became a perfect Actinia; he then cut pieces from these with the same result, and ultimately got fourteen from the orginal one.

The ordinary mode of reproduction in these zoophytes is by minute germs or ova, which are to be found suspended in dense clusters in the interior of the animal; these escape into the creature's stomach, and are discharged into the sea through the mouth. Some of the Actiniæ are exceedingly prolific, producing from 150 to 300 young in a single day. The characteristic form and markings of the parent are distinctly recognisable in the newly-born progeny, the principal distinction, besides the difference of

size, being the fewness of the tentacles, which at first are only about twelve in number.

The **Mushroom Corals** (*Fungiæ*)* are so called on account of a striking resemblance between the arrangement of the stony laminæ upon the upper surface of their framework and the gills of a mushroom (Fig. 42). This, however, is but the skeleton, and though it is a very pretty object, those who are acquainted with it alone can form from it but a very poor idea of the living animal. When removed from its native element, the violence at first causes the soft living flesh to contract so forcibly that scarcely any difference is perceptible between it and the dry skeleton, nor is any alteration at once manifest on putting it into salt water. But let it recover its confidence, its equanimity, then a pellucid gelatinous flesh will be seen emerging from between the plates, from which arise exquisitely formed and coloured tentacles fringing the surface, across which stretches the mouth, resembling a slit with white plaited lips, like the orifice of a cowrie shell.

FIG. 42.—FUNGIA.

* Fungus, *a mushroom.*

CHAPTER VII.

ECHINODERMATA.*

It is beautiful to observe by what gentle steps the student of Nature is able to ascend, from the contemplation of one form of animal life to another more elevated in the scale of creation. We have learned, in the preceding chapter, that many tribes of the Polypes secrete calcareous matter in large quantities, and thus construct for themselves a solid framework, which sustains the living mass. Let us, for a moment, suppose a Polype supported upon a long stem, capable of strengthening its pedicle, its body, the tentacula around its mouth, and all the appendages belonging to the animal, with solid pieces of definite form, such pieces being connected together by the soft parts and surrounded on all sides with living flesh, would thus form an internal skeleton, giving strength and support to the entire fabric, and at the same time allowing it to bend in every direction. A Polype so constituted would, when dried, present an appearance resembling that depicted in the annexed figure (Fig. 44, 7). The creature represented, however, is not a Polype, but an

Encrinite,† one of the lowest of the class of Starfishes. In its habits of life an Encrinite, thus constructed, closely resembles the more highly-organized Anthozoa. Fixed by its jointed stem upon the surface of the rock, it curves its pedicle from side to side in search of food, which with its flower-like arms, it seizes and conveys into its mouth. These Encrinites are, in modern times, the scarcest productions of the ocean. A species similar to that in our engraving exists in the West Indian seas; and

* ἐχῖνος, echinos, *a hedgehog*; δέρμα, derma, *skin.*

† ’εν, en, *in*; κρίνον, krinon, *a lily.*

not many years ago, the interesting discovery was made of another species upon our own coasts; this, however, is of very small size, not exceeding three-quarters of an inch in length—with these rare ex-

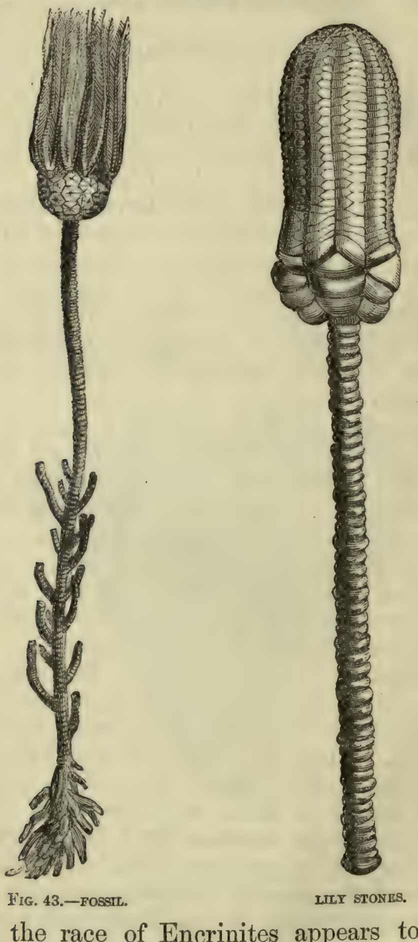

FIG. 43.—FOSSIL. LILY STONES.

ceptions, the race of Encrinites appears to be extinct. Yet the time has been when the bottom of the sea must have been as thickly covered with

creatures of this description as a corn-field is with corn. Many large kinds are found in a fossil state in our chalk and limestone rocks, and vast strata of marble, extending over large tracts of country in Northern Europe and in North America, are entirely made up of their petrified skeletons.

"Man applies it to construct his palace and adorn his sepulchre; but there are few who know, and fewer still who appreciate, the surprising fact that much of this marble is composed of millions of the skeletons of organized beings, once endowed with life, and susceptible of enjoyment, which after performing the part that was for a while assigned to them in living Nature, have contributed their remains towards the composition of the mountain masses of the earth."—DR. BUCKLAND.

The numerous pieces of which their stems were formed are met with in abundance in the north of England, where they are popularly known as St. Cuthbert's beads, while their polype-like heads have been regarded as petrified flowers, and designated "Lily stones" (Fig. 43). The origin of these beautiful fossils, formerly so mysterious, is thus easily explained.

The **Feather-star** (*Comatula*)* (Fig. 44, 6), common upon our coast, is but an Encrinite without a stem, and thus enabled to move freely at the bottom of the sea. The central box which contains the stomach is furnished with a mouth, around which radiate the arms, fringed with a double row of jointed filaments; by means of these the Feather-star can creep upon the sand, or twining them around the stems of sea-weeds or corals, it can climb in search of food, or by the undulations of its feathery filaments, row itself from place to place through the water, with a graceful gliding motion.

The **Sea-baskets** (*Gorgonocephalus*) † (Fig. 44, 5). In these elaborately-constructed creatures, the shell of the living animal is entirely covered with a thick fleshy crust. From the circumference of the disk proceed five strong rays,

* Comatus, *having hair*.

† Γοργών, Gorgon, *Medusa*; κεφαλή, kephale, *the head*.

which subdividing again and again, always by binary division, soon become multiplied into living ropes, spread out all around the body; and being made up of an immense number of jointed pieces, they are as flexible as whip-cord, and as manageable as the legs of a spider. Each of these innumerable cords is, in the living animal, terminated by a

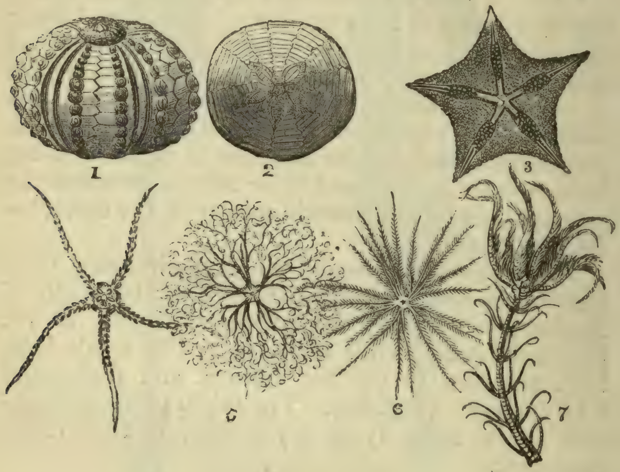

FIG. 44.—ECHINODERMATA.

minute yellowish fleshy ball, something resembling a little foot, so that the whole creature, as it walks along, appears like a conglomeration of serpents, strangely linked together, whence it has, not inappropriately received its mythological name of Gorgonocephalus, or Medusa's Head. These Star-fishes inhabit the deep parts of the sea, and seem principally to frequent coral-beds and localities where marine plants are abundant, around which they wind their arms, and thus crawl about in search of sustenance. The intertwined assemblage of their living tendrils forms a sort of net, in which small animals are entangled and dragged towards the mouth. "This elaborate piece of Nature," says its first describer, "has its body resembling an Echinus, or Egg-fish, the main branches a star, and the dividing of the branches, the plant misseltoe. It spreads itself from a pentagonal root into five main limbs or

branches, each of which, just at the issuing out from the body, divides itself into two, and each of the ten branches thus formed, does again divide into two parts, making twenty lesser branches, and each of these doth again divide, making in all forty. These again divide into eighty, and these into 160, and they again into 320. The division is again repeated, making 640, afterwards 1,280, 5,120, 10,240, 20,480, 40,960, and at the fourteenth division, beyond which the farther expansion could not be distinctly traced, there were 81,920 small tendrils or threads in which the branches of this Star-fish terminate."

We next arrive at a group called

Snake-tailed Star-fishes (*Ophiuridæ*),* one of which is represented at Fig. 44, 4. The rays are no longer divided into branches, but are, nevertheless, curiously constructed, and being twisted about with great activity when the creature is disturbed, look not a little like the tails of serpents—whence the name given to this family.

A very interesting circumstance in the economy of these animals is their extreme brittleness, whence they have merited the name of "*Brittle-Stars.*" On the least

FIG. 45.—BRITTLE STAR.

alarm or excitement, the creature throws off one or perhaps all its rays, and breaks them into fragments. This

* ὄφις, ophis, *a snake*; οὐρὰ, oura, *the tail.*

faculty renders the preservation of a perfect specimen very difficult.

These Snake-tails live almost exclusively on sandy shores, and hide themselves in the sand or mud at the slightest appearance of danger. In our own seas they are very abundant, and are amongst the most curious and beautiful game sought after by the dredger.

Some species are always found firmly grasping the stems of Gorgoniæ, amongst which they seem to live like spiders, catching any passing animals by means of their long flexible arms.

The **Star-fishes** (*Asterias*)* (Fig. 44, 3).

In these well-known animals it is evident that the power of locomotion, so far as depends upon the flexibility of the rays, must be entirely lost; it, therefore, becomes an interesting question how progression is now to be effected under such altered circumstances. On placing a living star-fish in some transparent pool left by the tide, and watching it there, the most incurious observer will find himself compelled to gaze in mute astonishment at what he sees. From the inferior surface of each ray, the creature, which before appeared so helpless and inanimate, slowly protrudes numbers of fleshy tubes, which move about in search of a firm holding-place, and soon are fixed, by means of little suckers at the end of each, to the smooth surface of a neighbouring stone; or, if the star-fish has been placed in a glass vessel filled with sea-water, to the inner surface of the glass, where every movement may be plainly seen. When these have laid fast hold, others appear in quick succession, and likewise are attached to the smooth surface, till at last hundreds of little legs, for such these suckers seem, are actively employed, and by their aid the creature glides along with such a gentle motion that it seems to swim rather than crawl.

But it is not merely as agents of locomotion that the suckers are used, for helpless as these creatures seem to be, they are in reality among the most voracious inhabitants of the deep. When seizing its food, the rays of the star-fish are bent so as to form a kind of cup, in the centre of which is the opening of the mouth. The cup thus formed will, to a certain extent, lay hold of a passing victim, but without other means of securing it, the grasp

* ἀστὴρ, aster, *a star*.

would scarcely be formidable to animals possessed of any strength; armed, however, as the rays have been seen to be with hundreds of tenacious suckers, escape from such a grasp is hopeless, for prey once seized is secured by every part of its surface, and in spite of its utmost efforts, is speedily dragged towards the mouth of the star-fish, and engulphed in its capacious maw. Small crabs and

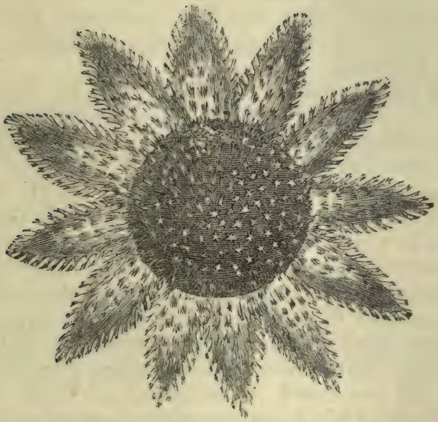

FIG. 46.—FIGURE OF SUN-STAR—SOLASTER PAPPOSA.

small shell-fish are swallowed entire, for the stomach is amazingly dilatable; but shell-fish of large size are not the less the victims of the creature's voracity, although it cannot swallow them whole. The destruction which it commits among oysters was well-known to the ancients, who believed that it obtained its supper by inserting one of its rays, after the manner of an oyster-knife, between the shells when the oyster happened to lie with them partially open, and that it then gradually forced itself in till the prey came in contact with its mouth. This procedure, although sufficiently ingenious, is not the mode pursued, at least by our modern star-fish, which has the singular faculty of turning its stomach inside out and pouring from it a poisonous secretion, which being introduced between the shells of the oyster deprives it of all power of closing its valves. The protruded stomach of the star-fish is then thrust in, and enveloping the poor oyster in its folds, literally eats it out of house and home.

These animals abound on every coast, frequenting quiet bays, where they are of important use. Their appetite and instinct lead them to devour whatever dead or tainted substance they may happen to encounter, and thus by their multitudes they prevent our shores from being encumbered by the offal that would otherwise accumulate on every beach. They are, moreover, highly prolific, pouring forth at certain seasons their innumerable eggs into the surrounding water, and thus materially contributing to the supply of food provided for the multitudinous inhabitants of the sea.

In the **Cake-urchins** (*Scutella*),* (Fig. 44, 2), the rays are obliterated, and the circumference acquires a circular form; moreover, their body is completely encased in a hard calcareous shell, composed of numerous angular pieces, accurately fitted together and incapable of movement. The Cake-Urchins bury themselves in the sand, a situation in which suckers would be of little use, but for which they are admirably adapted by a contrivance not less calculated to excite the admiration of the observer.

The exterior of the *Scutella* is entirely covered with minute appendages, resembling, when seen with the naked eye, delicate hairs; but, when examined with the microscope, they are found to be spines of most elaborate structure, all of which are moveably attached to the shell by ball and socket-joints, and thus rendered susceptible of being moved in every direction, so that by their combined efforts the animal can speedily bury itself, either for the purpose of procuring food or of eluding observation.

The **Sea-eggs** or **Sea-urchins** (*Echinus*)† (Fig. 44, 1), in their form resemble an orange. The mouth is a simple orifice in the shell, placed at one extremity of its axis, and through it, as represented in the figure, the points of five singular teeth project externally. The instruments of locomotion occupy the entire superfices of the shell, and present two distinct sets of organs adapted to dffierent uses. The first consists of a multitude of sharp, purple spines (Fig. 47), every one of which is connected by a ball and socket-joint to a distinct prominence on which it moves. These numerous spines, therefore, are so many

* Scutellum, *a little shield.*

† ἐχῖνος, echinos, *a hedgehog.*

inflexible legs, upon which the Echinus rolls itself from place to place, or by their assistance it can bury itself in the sand with the greatest facility. But these wonderfully-constructed animals are by no means confined to this mode of progression; for impossible as it might seem from their outward appearance, they are able to climb rocks in search of food, and thus obtain the corallines and shell-fish upon which they principally feed. To enable them to effect this, their shell is perforated with ten rows of small orifices, extending from one pole to the other, like the lines of longitude upon a globe, through which long suckers issue similar in structure to those of the star-fish, but long enough to extend beyond the points of the spines; so that, by their assistance, the *Sea-Urchin* not only scales the cliff, but creeps along pendent from the roofs of submarine caverns.

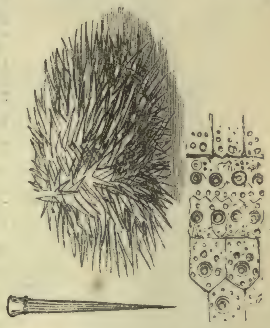

FIG. 47.—GREEN-PEA URCHIN.

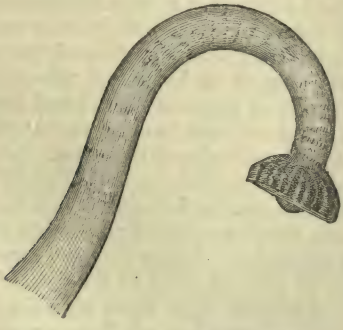

FIG. 48.—FIGURE OF SUCKER OF URCHIN.

The number of these suckers is very great: in a moderate-sized Urchin, Professor Forbes reckoned sixty-two rows of pores in each of the ten bands; as there are three pairs of pores in each row, their number multiplied by six and again by ten would give three thousand seven

hundred and twenty pores; but as each sucker occupies a pair of pores, the number of suckers would be half that amount, or one thousand eight hundred and sixty. Nor is the structure of these animals less complicated in other respects. The shell is made up of above three hundred pieces of one kind, and nearly as many of another, all dove-tailing together with the greatest order and regularity, bearing on their surfaces above four thousand spines; nay, if we cut any individual spine into slices and examine it with a microscope, it will be seen to present a pattern peculiar to the species, and far beyond the reach of art in its elaborate beauty (Fig. 49). Truly the skill of the great Architect of nature is not less displayed in the construction of a Sea-Urchin than in the creation of a world!

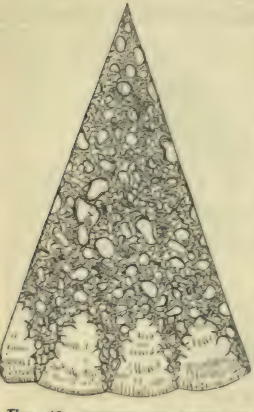

FIG. 49.—FIGURE OF SPINE OF ECHINUS—SEGMENT OF SECTION.

The eggs (or roe) of the Echinus are looked upon in some countries as affording a very excellent dish, and we find that among the Romans they were accounted delicacies. It is recorded that they formed the principal dish at the famous supper of Lentulus, when he was made Flamen Martialis, or priest of Mars; and Sea-Urchins are still caught in great numbers upon the shores of the Mediterranean, for the sake of their roe.

The **Sea-cucumbers** *(Holothuriæ)** (Fig. 50). The fisherman's dredge occasionally brings up, on our own coasts, slimy creatures, bearing no slight resemblance to a disagreeable-looking cucumber, whence they are commonly known by the name of *Sea-Gherkins* or *Sea-Cucumbers.* It is in tropical seas, however, that these animals most abound, where they lie in the mud or shallows, or crawl over the coral rocks. The surface of their bodies is composed of a dense, tough, leathery skin capable of being dilated or contracted, lengthened or shortened at the will of the animal. No stony shell is deposited upon their bodies;

* *ὁλοθούριον*, holothourion, a name applied by Aristotle.

nevertheless, their relationship to the Urchins and Sta fishes is manifestly shown, by their apparatus of locom tive suckers, which are of precisely the same structure those of the Echinus. As if, however, also to manife an affinity with the Polype forms, there still exists in t Holothuria a circle of branched tentacles, which surroun

FIG. 50.—HOLOTHURIÆ.

the mouth. These are capable of being withdrawn in the body, but are commonly protruded in expectation prey, which is seized and dragged to the mouth by the appendages. They greatly resemble in appearance t tentacles of some of the *Actiniæ*, especially when t *Holothuria* has buried its whole body in the mud or san with the exception of these branched tentacles, whic expand like the petals of a flower. A species named

The **Cotton-Spinner** (*Holothuria Nigra*), sometimes called t "Nigger," is very common in deep water, off the coast of Cornwal it is held by the fishermen in great detestation, on account of i slimy appearance, and from an idea that where the "Niggers" a numerous, and get into the Crab-pots, neither crabs nor lobsters a caught. These animals are frequently near a foot in length, a thick in proportion. They sometimes draw themselves up into kind of ball, and if touched or disturbed, throw out a bunch white taper threads of great tenacity, that stick to everything th touch, and no doubt constitute a means of defence.

The **Siphon-worms** (*Sipunculus*)* (Fig. 51) have a lengt ened and slender body, and all the aspect of *worms*, wit

* Sipunculus, from σιφον, *a tube*.

the exception of the circle of tentacles around their mouths, by which they indicate their lingering affinity to the Echinoderms. They have no suckers or feet, and many species are marked by wrinkles encircling their body, causing them to resemble earth-worms in their appearance as well as in their habits. Most of them bore deep holes in the sand, wherein they lodge. Others conceal themselves in the crevices of rocks; and there is one species, *Sipunculus Bernhardus*, represented in our engraving (Fig. 51), which selects the shell of some periwinkle or whelk for its abode.

FIG. 51.—HERMIT SIPUNCULUS.

CHAPTER VIII.

ENTOZOA* (*Parasitic Worms*).

LAVISHLY as we have already found the world to be filled with the lower forms of animated beings, our astonishment will be by no means lessened, when we learn that innumerable creatures have been ordained to lead a parasitic life, and to procure their nourishment from the superabundant juices of other animals; neither is this race of parasites by any means deficient in numerical importance, or constructed with less careful adaptation to the situation in which they are destined to reside; they present, however, little to invite our attention, and the details

* ἐντός, entos, *within*; ζῶον, zoon, *an animal*.

known concerning their general economy are, as yet, extremely few and unsatisfactory.

One of the most common is

The **Hydatid** (*Cysticercus*), which not unfrequently infests the flesh of pigs, causing that diseased condition which is known as *measly pork.* Its body consists of a globose transparent bag, with a slender neck, terminated by a remarkable prehensile apparatus—consisting of a double row of recurved spines and four adhesive suckers—represented upon an enlarged scale upon the right-hand

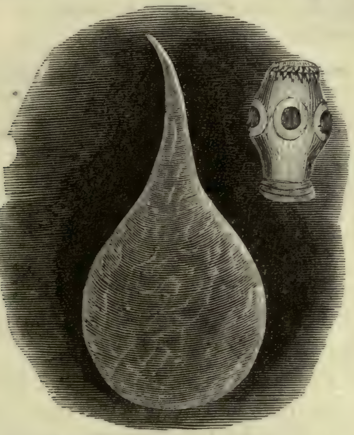

FIG. 52.—FIGURE OF CYSTICEREN.

side of the figure. These simply-constructed animals, formerly regarded as a distinct species, have been proved by recent experiments to be but an incomplete condition of

The **Tape-worms** (*Teniæ*), many species of which are met with in the alimentary canal of various animals, where they have been known to attain the length of sixty, or even a hundred feet. The body of the tape-worm consists of a great number of segments, sometimes amounting to five hundred or more; these become very slender as they approach the so-called head (*scolex*), from which they are all successively produced.

The **Flukes** (*Distoma*) constitute a very numerous race, of which the *Liver Fluke, Distoma hepaticum,* but too well known as inhabiting the liver of the sheep, will serve as an example. It resembles in shape a little sole, about an inch in length, furnished with two suckers, each of which was at one time supposed to be a mouth—whence the origin of their name. When sheep are pastured in low wet meadows, this animal often multiplies in them excessively, producing dropsy or rot, and finally causing the death of the poor creatures so infested.

The **Guinea-worm** (*Filaria* Medinensis*) is a most troublesome animal in hot climates, where it takes up its residence under the skin of our legs and feet, and sometimes causes very serious annoyance. It is more especially met with on the Guinea coast of Africa, and thence derives its name. This plague of the human race, although not thicker than a knitting needle, sometimes measures upwards of a yard in length: how it gets into its selected abode it is not easy to conjecture; but when once located it seems to make itself quite at home, causing painful tumours: on arriving at maturity it comes to the surface, when it is carefully extracted by the Arab or negro doctors.

We have in this country a worm of very similar structure, called

The **Hair-worm** (*Gordius*)†, common in summer time in ponds and ditches, so closely resembling in its appearance a hair from a horse's tail, that in former times it was the popular belief that they were really living horse-hairs; their history is somewhat curious. They pass the early part of their life in the interior of some insect, generally a water-beetle, where they grow to the length of ten or eleven inches. When full grown, they escape from the body of the poor insect in which they have been nourished, and seek some piece of water, or moist situation, where they deposit their eggs in long chains.

TURBELLARIA.‡

Another large group of worms, although closely allied to the Entozoa, are not parasitic. Their body is flat, soft, and often very contractile, but their chief distinguishing character is that they are entirely covered with cilia, by the movements of which they glide over any smooth surface. They are divisible into two families, the *Planariæ* and the *Nemertes* both of which merit description.

The **Planarias** (*Planaria*)§ are to be found abundantly in almost every pond, where they have very much the appearance of little slugs. These animals are of a gelatinous consistence, and enjoy such a power of self-contraction, that they can reduce their whole substance to the form of a speck of jelly, in which condition they occasionally force themselves rather disagreeably upon the notice of incautious water-cress eaters. The Planariæ inhabit

* Filum, *a thread.*

† Gordius, *a man who tied a very hard knot.*

‡ Turbella, *a commotion*, because the action of their cilia makes a stir in the surrounding water.

§ Planus, *flat.*

both salt and fresh water, where they swim about rapidly, by an undulating movement of their body, somewhat after the manner of a leech, and creep with great ease upon aquatic plants. They are generally of small size, but exceedingly voracious. Like the Polypes, they appear capable of almost endless increase by division. Sir J. Dalyell, speaking of the Black Planaria (*P. nigra*) says, "it is privileged to multiply its species, in proportion to the violence offered. It may almost be called immortal under the edge of the knife. Innumerable sections of the body, all become complete and perfect animals. If the head be cut off, a new head replaces it; if the tail be severed, a new tail is acquired."

The mouth of the Planariæ is a very remarkable structure. Near the middle of the under-surface there are two transverse slits, from the anterior of which a funnel-shaped organ, like a cup, can be protruded. This acts as a mouth; it is soft, highly irritable, and when drawn within the body is folded up, like the bud of a plant. This singular mouth opens immediately into the stomach; it can be protruded at pleasure, and applied to the surface of such larvæ or little worms as may come within reach, so as to suck from them the juices that they contain, or if the prey be small, it is immediately swallowed.

But the most wonderful creatures belonging to this group are

The **Long Sea-worms** (*Nemertes*),* occasionally to be met with by the sea-side explorer, coiled up under loose stones. The length of this extraordinary production of Nature is positively prodigious; and its whole history has more the appearance of fable than of sober truth.

"When I took it up at the sea-side," says the Rev. Mr. Davis (Linn. Trans.), "collecting such an immense creature into an oyster-shell, a very large one indeed, I thought it would have been almost impossible to unravel it; but it is astonishing to think how easily it was disentangled, owing to the extraordinary smoothness of its surface. It is impossible to make even a guess at the length of it when alive, on account of its always extending and contracting itself when touched, and that with such ease, as almost to exceed belief; but I may well say that it is capable of extending itself without inconvenience to twenty-five or thirty times the length that it presents at another period. It being impossible while the animal was alive to make any reasonable conjecture as to the length of it, I took it out of the bottle, and examined it when dead, when I found it to be two-and-twenty feet long, exclusive of the proboscis. Now I give it

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* *νημερτής*, nemertes, *no mistake about it.*

as my firm opinion, that I speak within bounds when I say the animal, when alive, might have been extended to four times the length it presented when dead. It is, therefore, by no means improbable that this most astonishing creature may have been susceptible of being drawn out to the length of twelve fathoms, or, according to the accounts of the fishermen, to thirty yards, or fifteen fathoms."

"The ignorant spectator," says Sir John Dalyell, "might almost suppose this animal to be only designed to be an inconvenience to itself. Who can affirm that he has ever seen the long sea-worm entire? that he had before him this giant of the race, or who can presume that those, apparently of the largest size, shall grow no more?

"Unwieldy and unmanageable as this creature seems, it attacks and devours other worms of all sorts. Portions of mussel are always acceptable, and are greedily swallowed by its capacious mouth. If the valves of a mussel be sundered, the animal fastens upon one of them, drags it away, and consumes the contents at leisure. When he desires to shift his quarters, he stretches out his body like an enormous snake; the eye sees no contraction of muscles, no apparent means of locomotion, but the microscope teaches us that the Nemertes glides along by the help of the minute vibratory cilia, with which his whole body is covered; he hesitates, he tries, and at last finds a stone to his taste, whereupon he slowly unrolls his length to convey himself to his new resting-place; and while his entangled folds are unravelling themselves at one end, they are forming a new Gordian knot at the other."

CHAPTER IX.

SECOND GRAND DIVISION OF THE ANIMAL KINGDOM.

ARTICULATED* ANIMALS.

WE have now arrived at the second great division of the animal creation, which includes a vast assemblage of creatures adapted to exist under a far greater diversity of circumstances than those we have as yet had an opportunity of examining. The most obvious character by which they are distinguished is met with in their exterior conformation. They are composed of a succession of rings, formed by the skin or outward integument, which, from its hardness, con-

* Articulatus, *jointed.*

stitutes a sort of external skeleton. In the lowest forms the body is extremely elongated, the segments proportionately soft and numerous, and, as a necessary consequence, limbs either do not exist, or are feeble and imperfect. Such is the srtucture met with in the **Annelida,** or **Worms,** as for example, in the leech (Fig. 53).

As we advance, we find the tegumentary rings become less numerous, and the skin of a denser and more firm texture, adapted to sustain the action of stronger and more powerful muscles; the limbs likewise become more elaborately formed, their movements more free and energetic. Moreover, the instruments of sight and touch begin to assume considerable perfection of structure. This state of development we find in the **Myriapoda** or **Centipedes** (Fig. 55).

In the **Insects** the perfection of the

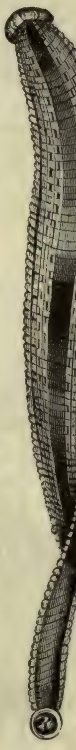

FIG. 53.—LEECH.

FIG. 54.—DIVISIONS OF A BEETLE.

external skeleton is still more remarkable, and the integument acquires a hardness and solidity pro-

portioned to the vigorous movements of which the limbs are now capable. The rings of the body, hitherto distinct, become more or less soldered together in those parts where the greatest strength and firmness are necessary; and scarcely any traces are left to indicate their existence as separate pieces; so that, instead of exhibiting that succession of similar segments seen in the centipedes, the body becomes divided into three distinct portions; namely, the *head*, which contains the organs of the senses and the parts of the mouth, the *thorax*, supporting the limbs, or instruments of progression, and the *abdomen*, enclosing the viscera subservient to nutrition and reproduction. (Fig. 54.)

In the fourth division of articulated animals, namely, the **Arachnida** (*scorpions, spiders, &c.*), a

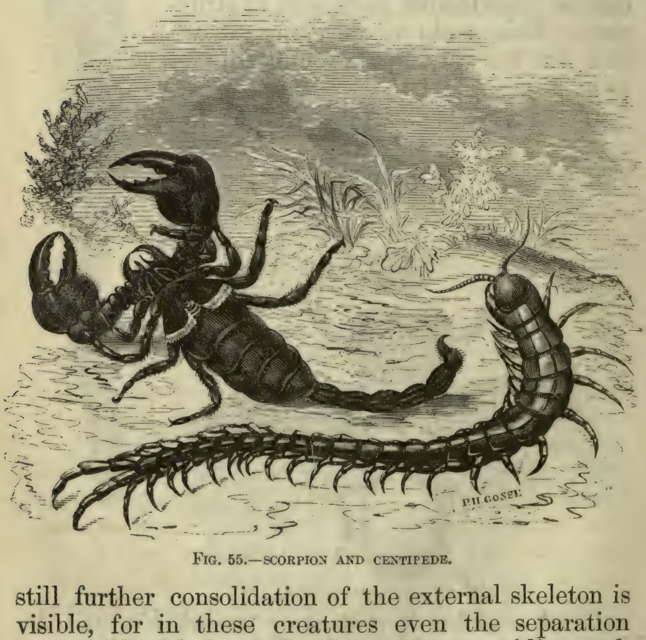

FIG. 55.—SCORPION AND CENTIPEDE.

still further consolidation of the external skeleton is visible, for in these creatures even the separation between the head and the thorax becomes obliterated,

and it is in the abdomen only that the segments of the body are recognizable. By contrasting the body of a centipede with that of a scorpion, as represented in the accompanying figure (Fig. 55), the progress of this coalescence of the tegumentary rings is strikingly exemplified.

Lastly, in the **Crustacea** (*crabs, lobsters, &c.*) we find various modifications of the outward skeleton adapted to the habits of the different races. Among the lowest forms, the rings composing the external framework are perfectly distinct and separate, resembling those of the myriapoda; but in the stronger and more predacious tribes the pieces of the head and thorax become solidly fixed together; and in those forms most adapted to a terrestrial life, namely, the *crabs*, almost all traces of distinction between the

FIG. 56.—COMMON CRAB.

thoracic segments is lost in the construction of the calcareous shield, which covers and protects their whole body. (Fig. 56.)

In the animals described in preceding chapters the

nervous system, wherever it has been at all discernible, has existed only in the form of slender threads, without being accumulated into masses, or centres of perception. In all creatures, however, belonging to the articulate division of the animal kingdom the nervous system is arranged upon a plan which is sufficiently conspicuous throughout the entire series. A double chain of brains, or *ganglia*, runs down the central line of the body beneath the alimentary canal; and it is from the symmetry conspicuous in the arrangement of these that the most unmistakable character whereby the articulata are distinguished is furnished.

The first pair of brains or ganglia is always situated in the head, and supplies nerves to the eyes, to the antennæ, and to all the principal instruments of sensation; and on the proportionate size and development of these ganglia the perfection of the senses possessed by any of these creatures depends, consequently they are generally spoken of as *the brain*.

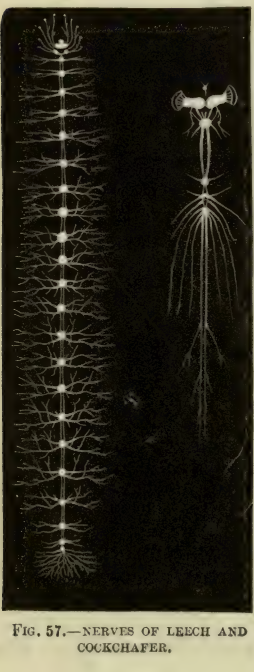

FIG. 57.—NERVES OF LEECH AND COCKCHAFER.

All the other ganglia are arranged in a double series along the floors of the different segments of the body, each supplying the muscles belonging to the rings in its neighbourhood. In proportion to the size and perfection of these ganglia, therefore, will be the energy of the creature's movements. In the annexed engraving (Fig. 57), representing the nervous system of a leech and of a cockchafer, it will be seen

that in the former the nervous centres are numerous and feeble, corresponding with the imperfection of the organs of sense and the absence of limbs, whereas in the latter they are proportionately large and few in number, adapted to the possession of senses of a higher description, and limbs endowed with great strength and activity.

The Articulata are divided into five principal classes, as represented in the following table:—

ARTICULATED ANIMALS.			
Blood, red or coloured	No articulated limbs		ANNELIDA.
Blood, white	Breathe air . .	Segments of the body similar—no distinction into head, thorax, and abdomen—legs twenty-four pairs or more in the adult—breathe by tracheæ—have no wings	MYRIAPODA.
		Body divided into head, thorax, and abdomen—have only three pairs of legs—generally provided with wings—respire by means of tracheæ . . .	INSECTA.
		Head consolidated with the thorax—no wings—have four pairs of legs—breathe by tracheæ or by pulmonary sacs	ARACHNIDA.
	Breathe water .	Have in general five or seven pairs of jointed legs . .	CRUSTACEA.

First Class of Articulated Animals.

Annelida—Worms.

The body of the Annelidans is composed of a succession of numerous rings, all of which are merely repetitions of each other. The first segment, although it differs but little from the rest, is called the head. The skin is generally soft, and the rings never horny or stony. Many Annelidans are entirely destitute of legs, as, for example, the leech (Fig. 53); and when these organs exist they are never formed of pieces jointed together end to end, as they are in insects, lobsters, or spiders; they are merely fleshy protuberances that support bunches of stiff *setæ*, or bristles, and are used as oars to row the animal through the water. (Fig. 58.)

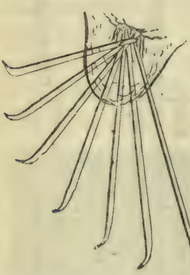

Fig. 58.—Foot of Nais.

Most Annelidans at the anterior extremity of their body are furnished with black spots, which appear to be eyes of very simple structure: they often have on the head, or on the sides of the neck, fleshy filaments called *tentacles*, which are not only delicate instruments of touch, but sometimes perform other important functions, as we shall see hereafter. In general these animals can crawl upon the ground by means of their setæ; many live buried in the earth, or are enclosed in tubes which they never leave; they mostly inhabit the sea, and are, with one or two exceptions, carnivorous.

The Annelidans are divided by zoologists into three orders, according to the nature and disposition of their respiratory apparatus. Some appear to

breathe by the general surface of their bodies, and have no special respiratory organs visible externally; these, therefore, have been called **Abranchia,*** without gills.

In a second division, the breathing apparatus consists of a series of tufts (Fig. 63) or fringes arranged along the middle or on each side of the back: these are the **Dorsibranchiata.**†

In the third order, **Tubicola,**‡ the Annelids inhabit a tube either composed of shell or manufactured by the agglutination of various materials. These have their branchiæ in the form of plumes or branching filaments attached to the head or neck (Fig. 65).

First Order—Abranchiate Annelidans.

This order comprehends two families, which differ widely from each other. The **Setigera,**§ which have locomotive appendages in the shape of delicate spines or bristles (*Earthworm, Nais*); and the **Suctoria,**|| which are destitute of such appendages, but are furnished instead with a prehensile sucker, attached to each extremity of the body (Leeches).

The **Earth-worms** (*Lumbricus*). The common well-known species (*Lumbricus terrestris*) attains nearly a foot in length, its body is composed of 120 rings or more, and is completely destitute of eyes or tentacles. Though a humble and despised creature, the earthworm is a most important item in the economy of nature. Piercing the ground in every direction, the earth is lightened by the united labours of their countless legions, and thus they materially conduce to its fertility. It consumes upon the surface of the ground, where they soon become injurious, the softer parts of decaying vegetable matter, and conveys beneath the soil the more woody fibres, where they moulder and form the nutriment of living vegetation. Thus eminently serviceable to the agriculturist, it likewise constitutes an indispensable article of food for innumerable creatures belonging to every order of creation; and perhaps is a solitary instance of an individual race subjected to universal destruction. The very emmets seize it when disabled, and bear it away as a prize: it constitutes

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* A "not," and branchia, *a gill.*

† Dorsum, *the back;* branchia, *a gill.*

‡ Tubus, *a tube;* colo, *I inhabit.*

§ Seta, *a bristle;* gero, *I carry.*

|| Suctorius, *sucking.*

throughout the year the food of many birds; fishes devour it greedily; the hedgehog eats it; the mole pursues it unceasingly; and secured, as it appears to be by its residence in the earth from creatures inhabiting a different element, many aquatic animals seem well acquainted with it, and prey on it as a natural food. Frogs eat it, and it is even seized occasionally by the great water-beetle (*Dyticus marginalis*), when used as a bait by the angler. Yet notwithstanding this prodigious destruction, its increase is fully commensurate with the consumption, as if it was ordained to be the appointed food of all.

The **Naides** (*Nais* *). The mud at the bottom of ponds and streams is frequently perforated by annelidans closely allied to the earth-worms. Their body is slender, and the rings into which it is divided are few, and but slightly marked. They commonly live in their burrows, merely protruding their head, which is furnished with a long proboscis, whereby they take their food, and for this purpose it is kept in constant motion. These water worms have a power of multiplication which is of a very surprising character. One of the most common species in our brooks (*Nais proboscidea*) consists, when full grown, of about fourteen segments. After a time, however, new segments begin to be formed a little in front of the tail; these lengthen, and soon begin to separate from the parent animal under the form of a new Nais provided with proboscis, eye-specks, and everything complete. Sometimes even before the newly-formed young has quite broken off its connection with its parent, another generation is in course of production near its own tail, and sometimes even this has begun to form a fourth before the separation of the first is complete.

The **Leeches** (*Hirudo*) are common in our ponds.

The **Medicinal Leech** (*Hirudo medicinalis*), however, is not indigenous in this country, but being easily obtainable we shall select it as an example of the group (Fig. 53). At each extremity of its body is a fleshy disc, which in progression acts as a sucker: it can, moreover, swim with much elegance but not with rapidity. Its mouth, situated in the middle of the front sucker, is furnished with three small semicircular teeth, each provided with a saw-like edge. These teeth are placed in a triradiate manner, so that when the action of the sucker has made the skin of its victim tense, their edges are pressed against it with a saw-like movement, until three cuts are made extending to some depth, and the blood thus liberated is largely sucked into the capacious stomach.

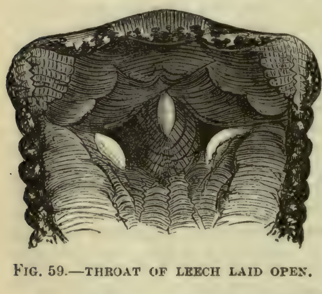


FIG. 59.—THROAT OF LEECH LAID OPEN.

* Nais, *a water-nymph.*

The tribe of leeches is very numerous; they all feed at the expense of other animals; they attach themselves to fishes and frogs; sometimes they devour molluscs, worms, or the larvæ of insects. Few animal substances are rejected; all kinds of fish, dead or alive, seem acceptable. Entering the larger fresh-water shells, the leech takes up its abode, an uninvited visitor, and remains until it has emptied them of their contents. They even devour other leeches. Sir J. Dalyell saw one half swallowed by a horse-leech scarcely double its size, and still struggling for liberty; but its ferocious enemy, adhering firmly by its sucker, and undulating its body in the water as if to aid deglutition, occupied three hours in finishing its meal. The use of the medicinal leeches is so general that they have become an important article of commerce, and are procured in great quantities from Spain and Russia. They may be preserved for a long time by placing them in moist earth or mud. On the approach of cold weather they bury themselves at the bottom of ponds, and pass the winter in lethargy, but they regain their activity in spring.

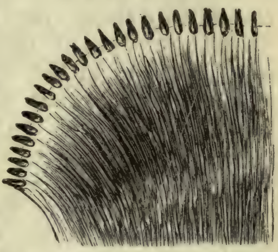


FIG. 60.—TOOTH OF LEECH MAGNIFIED.

When kept in large reservoirs with clay-banks fringed with rushes and aquatic plants, the leech will propagate its kind. It lays about a dozen eggs, enclosed in a mucous cocoon of an oval form, about a quarter of an inch long. In the month of August holes may be observed in the mud or clay of the banks, each of

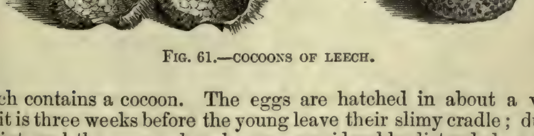


FIG. 61.—COCOONS OF LEECH.

which contains a cocoon. The eggs are hatched in about a week, but it is three weeks before the young leave their slimy cradle; during the interval the cocoon has become considerably distended, and the little animals are continually pushing its walls with their heads as if trying to find a weak point and escape. When at last their increasing strength enables them to burst forth, they are about a quarter of an inch long, and no thicker than a thread.

SECOND ORDER—DORSIBRANCHIATE ANNELIDANS.

In the **Dorsibranchiate Annelidans** the respiratory organs consist of fringes or arborescent tufts, distributed in pairs along the sides of the back. In some cases, every ring is thus furnished, but in others, only those rings which are near the middle. These worms are all free: they burrow in the mud or sand, or swim in the open sea; they are therefore supplied with organs of locomotion, which, for the most part, assume the form of moveable spines or packets of retractile bristles attached to each segment of the body.

It is not, however, by mere prosy description that we can convey to our readers any adequate idea of the beauty of these splendid worms; here we must let their great historian, M. de Quatrefages, speak for himself: his pen can best portray what his patient industry has so admirably displayed.

"Upon the Isle de Chaussy," says that distinguished anatomist, "the wandering Annelids occupied my special attention. Hitherto, I had only known this numerous family of sea-worms through engravings; and although I had formed a tolerably exact notion of their structure, I had not the slightest idea how many points of interest attached to them. When I had once surprised within their secure retreats the *Polynoe* with its lucid scales, the *Phyllodoce* with its hundred bright-green rings, the *Eunice* with its purple crest, the *Terebella* surrounded by a cloud of innumerable living cables which serve it in the place of arms,—when I had seen displayed before my eyes the rich fan of the *Sabella*, and the enamelled collar of the *Serpula*, I no longer smiled, as I had done before, at the thought of the naturalist having conferred upon them the most charming names he could think of. These despised creatures seemed to me no less worthy of a naturalist's homage than the most brilliant insect or the fairest

flower. Let no one prate to me any more about the violet as a pattern of modesty! The coquette! See how she shows from far her fresh tuft of green leaves, and scatters abroad the perfume that invites you to approach. More skilful than her rivals, she knows that mystery is the greatest of all attractions, and that the rose herself loses by displaying her charms in broad daylight; therefore it is that she seeks the obscurity of the woods and the shelter of the hedge-side. But look at the Annelids! what do they lack when compared with the most splendid inhabitants of earth or air? Yet they shun the light, they withdraw themselves from our view, but with no design to attract; and the naturalist alone knows where to seek the strange wonders which are hidden within the recesses of the rock, and beneath the sandy beds of the ocean. You may smile at my enthusiasm, but come and judge for yourself. All is prepared! Our lamp gives a light almost equal to a jet of gas, while a large lens, mounted upon a moveable foot, receives the rays of light, and concentrates them upon our field of view. We have just placed upon the stage a little trough filled with sea-water, in which an *Eunice* is disporting itself. See how indignant it is at its captivity; how its numerous rings contract, elongate, twist into a spiral coil, and at every movement emit flashes of splendour in which all the tints of the prism are blended in the brightest metallic reflections. It is impossible, in the midst of this tumultuous agitation, to distinguish anything definitely. But it is more quiet now; lose no time in examining it. See how it crawls along the bottom of the vessel, with its thousand feet moving rapidly forwards. See what beautiful plumes adorn the sides of the body; these are the branchiæ, or organs of respiration, which become vermilion as they are swelled by the blood, the course of which you may trace all along the back. Look at that head enamelled with the brightest colours; here are the few tentacles, delicate organs of touch, and here, in the

midst of them, is the mouth, which, at first sight, seems merely like an irregularly puckered slit. But watch it for a few moments; see how it opens and protrudes a large proboscis, furnished with three pairs of jaws, and possessing a diameter which equals that of the body within which it is enclosed, as in a living sheath. Well! is it not wonderful? Is there any animal that can surpass it in decoration? The corslet of the brightest beetle, the sparkling throat of the humming-bird, would all look pale when compared with the play of light over the rings of its body, glowing in its golden threads, and sparkling over its amber and coral fringes. Now, let us take a lens of higher power, and move the lamp in such a manner as to let its rays fall on the reflector of our microscope, and examine a few of the hairs taken from the sides of the Annelid we have been describing. To the outer edge of every foot are appended two bundles of hairs (*setæ*); these are far stiffer than ordinary hairs, and appear to be placed on either side of the animal to defend it from its enemies. A moment's consideration will suffice to confirm this view, for there is perhaps scarcely a weapon invented by the murderous genius of man whose counterpart could not be found amongst this class of animals. Here are curved blades, whose edges present a prolonged cutting surface, sometimes on the concave edge, as in the yatagan of the Arab, sometimes on the convex border, as in the oriental scimitar. Next we meet with weapons which remind us of the broad-sword of the cuirassier, the sabre, and the bayonet; here are harpoons, fish-hooks, and cutting blades of every form, loosely attached to a sharp

FIG. 62.—PUSHING POLES OF SERPULA.

handle: these moveable pieces are intended to remain in the body of the enemy, while the handle which supported them becomes a long spike, as sharp as it was before. Here we have straight or curved poniards, cutting-bills, arrows with the barbs turned backwards, but carefully provided with a sheath to protect the fine indentations from being blunted by friction, or broken by any unforeseen accident. Finally, if the enemy should disregard his first wounds, there darts from every foot a shorter but stronger spear, which is brought into play by a special set of muscles, so soon as the combatants are sufficiently near to grapple in close fight."

It is not without reason that nature has endowed these amazons with more finely-polished and sharper-pointed weapons than any wielded by the paladins of old: destined to live by rapine, and exposed to the attacks of a thousand enemies, they need them both as means of attack and defence. Almost all feed upon living prey. Some wait in ambush for the passing by of small Crustaceans, Planariæ, or other minute animals, and seize their victims with their proboscis, or entwine them in the folds of their numerous arms. Others, again, more active than the rest, pursue their game over the sand or through thick tufts of corallines and other marine plants. Some attach themselves to shells, and having perforated them, devour their inhabitants. The *Hermella* thus commits great havoc among the oyster-beds, destroying numerous colonies of this much-cherished mollusc. These Annelids are, in their turn, pursued by a multitude of carnivorous animals. Fishes wage a rude war against them, and if one, more imprudent than the rest, should abandon its retreat, or be exposed to view by the waves, it rarely escapes the murderous jaws of some whiting, sole, plaice, or eel. It is asserted that the latter kind of fish are well acquainted with the mode of drawing them out of the sand, as do the whelks. But crabs, lobsters, and a host of other crustaceans, constitute their most

formidable enemies, and are protected by their armour from the formidable weapons of the Annelida.

The **Sand-worm** (*Arenicola**) is exceedingly abundant on sandy shores, and is much sought for and used by fishermen as a bait. Its usual name on the coast is the "Lug," or "Lug-worm." It is of a greenish-red colour, and the gill-tufts, which form two rows upon the middle portion of its body (Fig. 63), are of a beautiful crimson, from the blood which circulates in them abundantly. This worm bores rapidly in the sand by means of its conical head; and as it moves on, the sides of the treacherous passage are prevented from closing up by a secretion from the body of the animal, which cements the particles together into a kind of wall. This, as the creature advances, is left behind, imitating, in miniature, the brickwork of a tunnel.

FIG. 63.—SAND-WORM.

The **Nereids** (*Nereis*†) have branchial tufts and locomotive oars appended to every segment; they are carnivorous, and their mouth exhibits a very singular structure. The commencement of the alimentary canal is capable of being turned inside out, like the finger of a glove. When thus everted, it appears like a thick proboscis, armed with a formidable array of sharp teeth, curved fangs, keen knives, and horny plates resembling rasps or files, the shape of which varies in different species, but always calculated to seize and retain passing prey. No sooner is some small animal seized by this wonderful apparatus, than the whole protruded proboscis is quickly inverted, carrying the hapless victim into the living cavern, from which there is no escape. Among the Nereids may be noted

The **Eunice** ‡ **Gigantea**, the largest Annelidan known; we have at this moment a specimen before us, which measures upwards of four feet in length, and consists of 448 segments, all provided

* Arena, *the sand;* colo, *I inhabit.*

† A nymph.

‡ A nymph.

with their complement of oars. It is a beautiful sight to see a man-of-war's barge full manned with sturdy rowers, gliding along over the level surface of the sea, the oars all keeping time with such precision that they seem to move as by one impulse. It is a grand spectacle to behold the meteor-like progress of a steam-ship as it cleaves its onward path; but far more beautiful, far more magnificent to the admirer of the works of Nature, to observe the movements of these splendid worms. Let any one imagine this gorgeous animal free in its native seas, blazing as it does with iridescent tints, that answer back again the glowing brilliancy of a tropical sun—while it rows along its "oary state" by means of upwards of 1700 distinct laminæ, all wielded with such energy, that the eye can scarcely follow their movements—and he will perhaps form some faint idea of the efficiency of a locomotive apparatus, such as is provided for the Dorsibranchiate Annelidans.

"With our notions of a worm," says Dr. Hartwich, "we generally connect the idea of incompleteness; we are apt to consider them as beings equally uninteresting and ugly, and disdain to inquire into the wonders of their organization; but a cursory examination of the Eunice would alone suffice to give us a very different opinion of these despised but far from despicable animals. Three hundred brains, from which about three thousand nerves proceed, regulate its movements. Two hundred and fifty stomachs digest its food; five hundred and fifty branchiæ refresh its blood; six hundred hearts distribute this vital fluid through its body; and thirty thousand muscles obey the will of the worm, and execute its snake-like movements. Surely there is here but little occasion to commiserate want, or scoff at poverty!"

The **Sea-mouse** (*Halithea* aculeata*) (Fig. 64) is common on our coasts, and is frequently dredged up from muddy ground. This Annelid is four or five inches in length, of a greyish hue, and clothed on the back with a fine silky down, under which are concealed fifteen pairs of scaly plates, one pair on each ring. The under surface is smooth, but marked by transverse divisions, indicating that it is formed of about forty rings or segments. On the sides project bunches of hairs resembling the finest silk, and bedizened with iridescent colours; they yield, indeed, in no respect to the most gorgeous tints of tropical

* ἅλς, als, *the sea*; θέα, thea, *a goddess*.

birds, or the brilliant decorations of insects: green, yellow and orange, blue, purple and scarlet,—all the hues of the rainbow play upon them with the changing light, and shine with a metallic effulgence only comparable to that which adorns the breast of the humming-bird. But it is not only for their dazzling beauty that these worms are remarkable; many of them are armed with spines, that constitute important weapons of defence; each of these spines is seen, under the miscroscope, to be a perfect harpoon, its point being provided with a double series of strong barbs, so that when the creature erects its bristles, much more formidable than the spines of a hedgehog, the most determined enemy would scarcely venture to attack it. These spines are all retractile, and can be drawn into the body by the muscular tube from

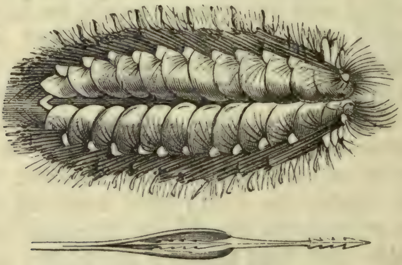


FIG. 64.—SEA-MOUSE.

which they spring. It would be superfluous to point out the danger that would accrue to the animal itself by the presence of such instruments embedded in its body, as by every movement they would be forced into its own flesh. The contrivance to obviate such an accident is as beautiful as it is simple: every barbed spine is furnished with a smooth, horny sheath, composed of two blades, between which it is lodged (Fig. 64), and these, closing upon the barbs, when they are drawn inwards, effectually protect the neighbouring soft parts from laceration.

THIRD ORDER—TUBICOLOUS ANNELIDANS.

The **Tubicolous Annelidans**, as their name imports, reside in tubes, which are either composed of a dense shelly substance, or constructed by gluing together fragments of sand, small stones, and other similar materials. To the former section belong

The **Serpulæ** * (*Serpulæ*) (Fig. 65), found on every coast, encrusting stones or shells, or any substance that has lain for any length of time at the bottom of the sea. The animal inhabiting these shells is a worm entirely destitute of limbs, but its front part, or head, during life presents a very beautiful spectacle, for from each side

FIG. 65.—SERPULA.

there spreads an elegant plume, composed of branched filaments of a rich scarlet or crimson hue, which float loosely in the water, and constitute the gills, or branchiæ. Besides these splendid branchial fringes, the head has one of its tentacles expanded into a broad, trumpet-shaped extremity, which accurately fits the mouth of the tube, so that when the creature is alarmed, it quietly draws in this singular trap-door, and remains securely shut up within its shelly abode.

The **Terebellæ** † inhabit factitious shells, composed

* Serpo, *to twist about like a serpent.*
† Terebellum, *a little auger or piercer.*

of grains of sand, fragments of shell, or even whole shells, small stones, and similar substances, which they glue together, and thus construct a beautiful tube, represented in the engraving (Fig. 66). This is effected by means of the tentacula that surround its head, which are extended in every direction in search of appropriate materials for the construction of their residence.

FIG. 66.—TEREBELLA MEDUSA.

The **Sabella * Alveolaris** often covers wide surfaces of rock near low water-mark, with its aggregated tubes. When the flood recedes, nothing is seen but the closed orifices, but when covered with the rising waters the sandy surface transforms itself into a beautiful picture. From each aperture stretches forth a neck ornamented with concentric rings of golden hair, terminating in a head embellished with a tiara of delicately-tinted tentacula, so that the whole looks like a garden-bed, enamelled with gay flowers of elegant forms and variegated colours.

CHAPTER X.

MYRIAPODA.†

THE Annelidans examined in the last chapter, with the singular exception of the earth-worm, are only adapted to an aquatic life. The soft integument which forms their outer framework, and the feeble organs appended to the numerous segments of their lengthy bodies, are far too weak to support their

* A proper name.

† *μυριάς*, murias, *innumerable ;* *πόυς*, pous, *a foot.*

weight in a less dense and buoyant element, so that, when removed from their native waters, they are utterly helpless and impotent. Supposing, as a matter of mere speculation, it was inquired, by what means animals so constructed could be rendered capable of assuming a terrestrial existence, so as to seek and obtain their food upon the surface of the earth, and thus represent upon land the Annelidans of the ocean; a little reflection would at once indicate the grosser changes required for the attainment of such an object. To convert the water-breathing organs of the aquatic worms into an apparatus adapted to breathe the air would be the first requisite. The second would be to give greater firmness to the tegumentary skeleton, to allow of more powerful and accurately applied muscular force, by diminishing the number of the segments, and by converting the lateral oars into jointed limbs, sufficiently strong to sustain the whole weight of the body, to provide instruments of locomotion fitted for progression upon the ground. Yet all these changes would be inefficient without corresponding modifications in the nervous system. The lengthened chain of minute ganglia, met with in the leech (Fig. 57), would be quite inadequate to wield muscles of strength adapted to such altered circumstances; the small brain would be incompetent to correspond with more exalted senses; so that, as a necessary consequence of superior organization, the nervous centres must all be increased in their proportionate development, to adapt them to higher functions. The changes which our supposition infers would be requisite for the conversion of an aquatic Annelid into a Myriapod, are precisely those which we encounter. The air-breathing animals which we have now to describe form the transition from the red-blooded worms to the class of insects, and are intermediate between these two great classes in every part of their structure. The body of a myriapod consists of a consecutive series of segments of equal dimensions, but un-

like those of the Annelidans, composed of a dense, semi-calcareous, or else of a firm, horny substance, and to every segment is appended one or two pairs of articulated legs, generally terminated by simple points.

The anterior segment, or head, besides the organs belonging to the mouth, contains the instruments of sense, consisting of simple or compound eyes, and of two long and jointed organs, called *antennæ*, generally regarded as ministering to the sense of touch, but which are probably connected with other perceptions unintelligible to us.

The air required for respiration is taken into the body through a series of minute pores, or spiracles, placed on each side along the entire length of the animal, and is distributed by innumerable ramifying tubes or tracheæ, to all parts of the system. The number of segments, and consequently of feet, increases progressively with age; a circumstance which remarkably distinguishes the myriapoda from insects properly so called. There are two families belonging to this class—the *millepedes* or **Julidæ**, which feed on vegetable substances, and the **Scolopendridæ**, or *centipedes*, which are carnivorous and rapacious.

The **Millepedes*** (*Julus*), are distinguished by their nearly cylindrical form (Fig. 67), their slow gliding motion produced by the alternate action of their very numerous little feet, sometimes more than a hundred

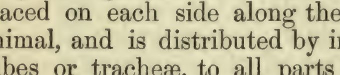


FIG. 67.—JULUS.

in number, and their habit of rolling themselves into a close spiral, when touched. They resort to damp and dark places, lurk under stones and moss, and are still more commonly found beneath the bark and in the wood of decaying trees. They are perfectly harmless, and feed entirely on decomposing vegetable materials. For this purpose their mouth is furnished with a pair of stout horny jaws, which move horizontally, and are provided at their cutting edges with sharp denticulations, so as to

* Mille, *a thousand;* pes, *a foot.*

render them effective instruments in dividing the fibres of rotting wood, or the roots and leaves of decaying plants. Most of them emit a very rank disagreeable odour. The female Millepede deposits her eggs, which are very minute, in the earth, or in the earthy powder of decayed wood. The young, when first hatched, are quite destitute of limbs, and have much the appearance of microscopic kidney beans. In the course of a few days, however, they throw off their first skin, and make their appearance, divided into about eight segments, of which the three that immediately follow the head, have each a pair of legs. In a few days more, a second moult takes place; the body is enlarged, the number of segments increased, and the number of limbs augmented to seven pairs on the segments succeeding the head. At the end of a month, or thereabouts, after another change of clothes, the young millepede appears with twenty-six pairs of feet, and so the process of exuviation is again and again repeated, until the creature arrives at its mature condition.

The **Centipedes*** (*Scolopendra*) (Fig. 55) are much more formidable creatures than the millepedes; they have a broad flattened body, composed of about four-and-twenty segments, to each of which is appended a pair of stout jointed limbs, well adapted, by the energy and activity of their movements, to the pursuit of active prey. The mouth of the Scolopendra is a terrible instrument of destruction, being not only provided with horny jaws, resembling those of Julus, but armed with a tremendous pair of massive and curved fangs, ending in sharp points, and perforated near their terminations by a minute orifice, through which a poisonous fluid is instilled into the wounds they inflict. Several small species are common in our gardens: but in hot climates they grow to a great size, and their bite, though rarely fatal, is more dangerous than the sting of the scorpion.

The **Giant Scolopendra** (*Scolopendra gigas*), common in South America, measures upwards of a foot in length, and an inch and a quarter across its body. Other species, scarcely less formidable, inhabit India and the adjacent islands, and abound in the hottest parts of Africa. They creep into houses, lurk under articles of furniture and behind wainscots, hide themselves in drawers and cupboards, and sometimes are found even in beds, much to the disgust

* Centum, *a hundred;* pes, *a foot.*

and apprehension of all who are not familiarised with their presence. The largest species met with in this country is—

The **Forked Centipede** (*Lithobius forficatus*);* it is found in the earth and under stones in our gardens, and is quick and active in its movements. It does not measure more than an inch and a quarter in length, and is of a tawny red colour, with fifteen feet on each side.

The **Electric Scolopendra** (*Scolopendra electrica*), likewise a British species, is occasionally luminous in the dark.

CHAPTER XI.

INSECTS (*Insecta* †).

HAVE patience with us, gentle reader—our task is no light one. To mete out the sands upon the sea-shore with a quart pot, to drain the ocean with a thimble, to count the stars, are ordinary expressions for impossibilities; but to condense the history of the Insect world into a few short pages, would be a miracle beyond them all. The number of species of insects, as we are told by entomologists, amounts to upwards of a hundred thousand; so various in their habits and their manners, their instincts and their appetites, that every species would itself furnish a large volume of interesting information, could we only penetrate the mysteries of their lives; and yet how little has been done in gaining anything like an intimate acquaintance with their daily duties, by a careful and watchful perusal of their economy. The secrecy of creation, however, is not to be rudely broken. Nature is a very coy mistress; watchful nights, anxious days, slender meals, and endless labours must be the lot of all those who pursue her through her labyrinths and meanders; nor will she ever confess to violence, what she is ready freely to disclose to patient and attentive solicitation. See the amateur entomologist, furnished with his nets and boxes, and all the adjuncts invented by art for

* λίθος, lithos, *a stone; βιόω*, bioo, *I live*—because it lives under stones.

† Insectum, *divided into segments.*

the purpose of waging war against the insect race, beating up the whole country, toiling over hill and dale with indefatigable perseverance, and so eager in his pursuit that he hardly allows himself time to stick his murderous pins through the unfortunate victims caught in his nets—and never wearying of his sport until his collecting box is converted into a great charnel-house, filled with their closely-packed and writhing bodies. He returns home, delighted with his success; but in spite of all his labour, he has not added a single item to our knowledge, or a single fact to the unknown history of any one species of his numerous specimens. This was not the way in which Reaumur or De Geer devoted themselves to the interrogation of nature; their efforts were directed not to the destruction, but to the preservation of the objects of their study. They wielded not the scissors of the Fates, wherewith to cut the frail thread of insect life; their method was to use it as a clue to guide them through the hidden labyrinths of the domestic history and habits of their favourites; they chose some fitting spot in the vicinity of the abodes of their protegés, and watched and chronicled their every action, until, by patient wooing, they at length succeeded in persuading them to confess the hidden mysteries of their avocations. They dealt with living nature, not with corpses, and their rich pages testify to the interesting result of their researches.

It is certainly instructive on a winter evening to examine with the microscope the various parts of a butterfly, and investigate their curious structure, but it is in the early morning, when the sun shines on the laughing earth, the flowers have opened, and all nature smiles, that the butterfly is to be seen in perfection, fanning the perfumed aïr with wings as white and pure as are the blossoms of the lily over which he plays, coquetting, as it were, to wake the jealousy of neighbouring roses. Is it coquetry, or is it that he knows not where to choose the sweetest nectar or the prettiest flower? See! how he now

advances, now retreats; returns and flutters off again, and then pounces down on a fresh violet, coyly peeping from beneath its leaves. And now the little rover takes his station, with a touch so light as not to discompose the perfumed velvet upon which he treads—his wings are motionless, and raised against each other. Now he uncurls his wonderful proboscis, and begins to sip the nectar offered so complacently, till satisfied away he flies, and Zephyr's self returning, finds no fold, or crease, or damage done to indicate the robbery committed. Such casual glimpses of Creation's charms are worth whole cabinets of cork and pins.

But to our subject. Let us first inquire,—What is an insect? In a German vocabulary, that happens by accident to be open before us, under the general name of "Insects," we find grouped together the following ill-assorted selection,—"Flies, Spiders, Ants, Scorpions, Frogs, Toads, and Lizards." It is, therefore, evident that the word "insect" is made use of in ordinary language, in a very vague and indeterminate manner, and applied indiscriminately to very various animals. Linnæus, it is true, employed it to designate all animals provided with an external skeleton, divided into segments (*insecta*), in which sense it nearly corresponded to the Cuvierian expression *articulata*, jointed, and thus included lobsters and crabs, spiders and scorpions, under the same designation. In the restricted sense in which it is now employed, however, it includes only such articulated animals, as in their perfect or mature state are recognizable by the following characters, whereby they are distinguished from all other creatures.

The body of an insect is divided into three principal portions, called respectively, the *head*, the *thorax*, and the *abdomen*.

The *head* contains the apparatus of the mouth, and instruments of the senses, including the *antennæ* or *feelers*, which are invariably two in number.

The *thorax*, formed by the union of three segments of the skeleton, supports *six* jointed *legs*, and generally *four*, sometimes *two wings*. These last, however, are frequently wanting.

The *abdomen* is destitute of legs, and contains the viscera, connected with nutrition and reproduction.

The legs of insects, as above stated, are invariably six in number, one pair being attached to each of the segments of the thorax. Considered separately,

FIG. 68.—HIND LEG OF BEE.

each of these legs is made up of several pieces, which well deserve our notice. The first division of the leg, or that in immediate connection with the thorax, is called the hip (*coxa*), and upon this, as upon a centre, the movements of the limbs are performed. To the extremity of the *coxa*, a small moveable piece is attached, called the *trochanter*, to which succeeds the thigh (*femur*), which is the thickest and most robust of all the divisions of the limb. The next piece, called the shank (*tibia*), is occasionally of considerable length, and is connected with the last by a hinge. To its extremity is appended the foot (*tarsus*), composed of a consecutive series of small segments, varying in number from five to one, the last of which is armed with claws, or other appendages, adapted to different kinds of progression. With these divisions of the leg, it is necessary that the student should be

thoroughly acquainted, as we shall again and again have to refer to them hereafter.

The wings of insects, when present, are invariably attached to the two posterior segments of the thorax, which are strengthened in every possible manner, so as to afford a support of sufficient density and firmness to sustain the violent exertions of the muscles employed in flight. Few things are met with in Nature more admirable than these structures. They present, indeed, a combination of strength and lightness absolutely beyond anything of human invention, and as instruments of flight they much surpass the wings of birds, both in the power and precision of their movements.

In the dragon-flies, by far the most powerful fliers in the insect world, all four wings are of equal size, and consist of a thin membranous expansion of great delicacy and of glassy appearance, supported at all points by a horny net-work (Fig. 69); these insects

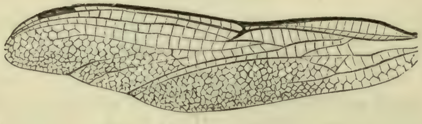


FIG. 69.—WING OF DRAGON-FLY.

can fly in all directions, backwards, and to the right or left, as well as forwards, with equal facility.

The substances employed as food by insects are various in proportion to the extensive distribution of the class. Some devour the leaves of vegetables, or feed upon grasses or succulent plants; others destroy timber, and the bark or roots of trees; while some, more delicately organized, are content to extract the juices of the expanding buds, or sip up the honied fluids from the flowers. Many tribes are carnivorous in their habits, armed with various weapons of destruction, and carry on a perpetual warfare with their own or other species; and, again, there are countless swarms appointed in their various spheres

to attack all dead or putrefying materials, and thus aid in the removal of substances, which by their accumulation might prove a constant source of annoyance and mischief. Such differences in their nature demand, of course, corresponding diversity in the construction of the instruments employed for procuring nourishment; and, accordingly, we find in the structure of the mouths of these little beings innumerable modifications, adapting them to different offices—jaws armed with strong and penetrating hooks for seizing and securing struggling prey—sharp and powerful shears for clipping and dividing the softer parts of vegetables; saws, files, and augers, for excavating and boring the harder parts of plants, lancets for piercing the skin of living animals, siphons and sucking-tubes for imbibing fluid nutriment—all these, in a thousand forms, are met with in the insect world, and thus provide them with the means of obtaining food adapted to their habits, and even of constructing for themselves edifices of inimitable workmanship.

The mouths of insects may be divided into two

FIG. 70.—PARTS OF THE MOUTH OF AN INSECT.

great classes, those which are adapted for biting, forming what is called a *perfect* or *mandibulate* mouth, and those which are so constructed as only to be employed in sucking, constituting the *suctorial* or *haustellate* mouth. It is in the former of these that all the parts are most completely developed. The perfect mouth of an insect consists of an upper and an under lip, and four horny jaws. The upper lip (*labrum*) (Figs. 70, 71, *a*) is a convex horny plate, placed transversely across the upper margin of the cavity in which the jaws are lodged, so that when the mouth

is shut, it folds down to meet the under lip (*labium*) *g*; and these two pieces more or less conceal the proper jaws which are lodged between them.

The upper pair of jaws (*mandibulæ*), *b*, are hard and powerful shears, placed immediately beneath the upper lip, and so jointed to the cheeks that they move horizontally, opening and shutting like a pair of scissors. Their concave edge is armed with strong denticulations of various kinds, sometimes furnished with cutting edges, that, like sharp shears, will clip and divide the hardest animal and vegetable substances; sometimes they form sharp and pointed fangs, adapted to seize and pierce their victims; and not unfrequently they constitute a series of grinding surfaces, disposed like the molar teeth of quadrupeds, to triturate and bruise the materials used as food. The variety of uses to which these mandibles can be turned is indeed amazing. In the

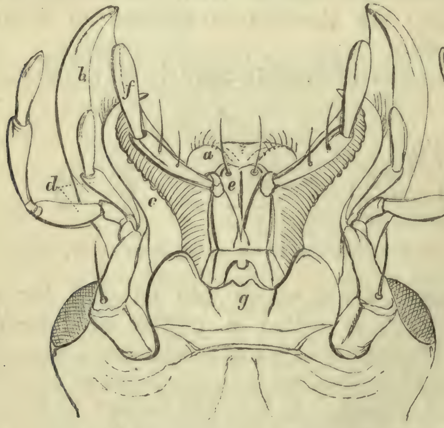


FIG. 71.—MOUTH OF A BEETLE.

carnivorous beetles their hooked points, more formidable than the teeth of the tiger, penetrate with ease the mailed covering of their stoutest congeners, and in the dragon-fly they are scarcely less formidable

weapons of destruction. In the locust tribes these organs are equally efficient agents in cutting and masticating leaves and vegetable matters adapted to their appetites, while in the wasps and bees they form the instruments with which these insects build their admirable edifices, and, to use the words of a popular author, supply the place of trowels, spades, pickaxes, saws, scissors, and knives, as the necessity of the case may require. Beneath the *mandibles* is situated another pair of jaws, *c*, of similar construction, but generally smaller, and less powerful; these are called the *maxillæ*. The lower lip, or *labium*, which closes the mouth inferiorly, consists of two distinct portions, usually described as separate organs; the chin, *mentum*, that really forms the inferior border of the mouth, and a membranaceous or somewhat fleshy organ, reposing upon the chin internally, and called the tongue (*lingua*). All these parts enter into the composition of the perfect mouth of an insect, and from the numerous varieties that occur in their shape and proportions, they become important guides to the entomologist in the determination and distribution of species.

The organs of sense in insects are distinct and well

FIG. 72.—VARIOUS ANTENNÆ.

developed, though we cannot, in all cases, precisely determine the sensations of which they are the

channels. Thus, the two jointed members called *antennæ*, that project from the head, are believed by some to be organs of touch; by others, to convey delicate perceptions unknown to us; and by the generality of entomologists are considered to be in some way sensible to sound. They are composed of a varying number of rings, sometimes as many as thirty, set in succession; the whole constituting a tube, and enclosing nerves, muscles, and air-pipes. Their form is exceedingly varied; and in many instances they are ornamented with feather-like beards, or curiously sculptured, so that they afford useful characters for the identification of the multitudinous genera comprised in this Class.

The eyes of insects present some interesting peculiarities of structure, indicative, no doubt, of corresponding diversities in the sense of vision, of which we must ever remain ignorant. Two distinct kinds of eyes are possessed by these animals, both kinds being present in the majority of species. If we examine the head of a bee, for example, we find a large convexity on each side, which a magnifying glass discovers to be composed of an immense number of facets, and on the summit of the head, between these, we see three shining points, resembling minute gems, set in a triangular form. The former are termed compound, the latter simple eyes. The simple eyes consist of a glassy lens, behind which a nervous thread is spread out, forming a *retina*, or net-work, as in the higher animals, to receive impressions of sight. The structure of these eyes is sufficiently intelligible, but our admiration is greatly excited when we come to consider the large convex organs of compound vision, and find that each of these contains many thousands of eyes, all capable of distinct perception. The microscope reveals to us that the compound eye of

FIG. 73.—EYES OF BEE.

an ant contains fifty lenses, that of a fly four thousand, that of a dragon-fly twelve thousand, that of a butterfly seventeen thousand, and that of a species of mordella (a kind of beetle), the amazing number of twenty-five thousand. Every one of these regular, polished, and many-sided lenses, is the external surface of a distinct eye, furnished with its own iris and pupil and a perfect nervous apparatus, as may be seen in the appended figure, representing the eye of a dragon-fly cut perpendicularly through the middle. As the eyes of insects are immoveably fixed in the head, it is probable that this great number of lenses and visual tubes is needful to see different objects, some or other of the component eyes being turned towards every point.

FIG. 74.—COMPOUND EYE OF A DRAGON-FLY.

The respiratory system of insects appears to be constructed with a view to insure a perpetual renewal of the vitality of the blood, combined with the utmost lightness, so needful for animals of which the great majority are denizens of the air. Hence we find neither lungs nor gills, but a series of tubes pervading every part of the body, by which the vital oxygen is carried to the blood. If we examine a beetle, a grasshopper, or a caterpillar, we shall observe a row of oval openings on each side, capable of being closed by thickened lips (Fig. 75). These are the spiracles or breathing apertures, for no insect breathes through the mouth; they admit the air into a main pipe which runs along each side of the body; these are connected by smaller branch pipes, which run across the rings of the abdomen, and distribute an infinite number of smaller tubes to every part of the interior. In insects of great powers of flight, there are likewise reservoirs of air; these are particularly large in the

bee. One circumstance connected with the arrangement of these air-tubes specially deserves our admiration. It is evident that the sides of canals so

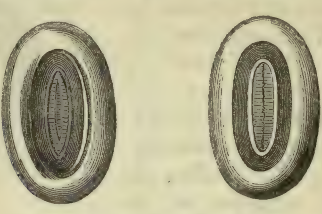


FIG. 75.—SPIRACLES OF INSECTS.

slender and delicate would inevitably collapse and fall together, so as to obstruct the passage of the air they are destined to convey, were not some plan adopted to obviate such an occurrence; and the only mode of providing against this would appear to be to make their walls stiff and inflexible. Inflexibility and stiffness would, however, never do in this case, where the tubes in question have to be distributed in countless ramifications through so many soft and distensible organs, and the problem, therefore, is how to maintain them permanently open in spite of external pressure, and still preserve the perfect pliancy

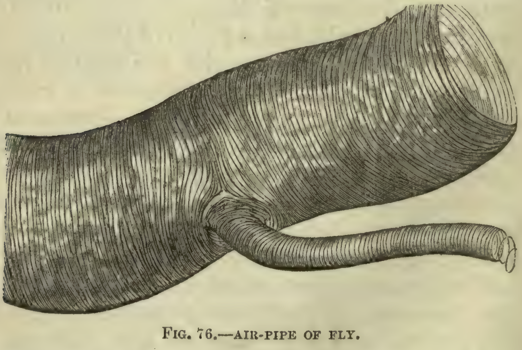


FIG. 76.—AIR-PIPE OF FLY.

and softness of their walls. The mode in which this is effected is as follows:—Between the two thin

layers of which each air-tube consists, an elastic thread is interposed, coiled in close spirals, of sufficient strength and firmness to maintain the channel always pervious, but not at all interfering with its flexibility; and this fibre, delicate as it is, may be traced with the microscope even through the utmost ramifications of the air-tubes. Wonderful are the results obtained by the adoption of this new arrangement. Not only is the body of the insect lightened to the uttermost, but the little creature, thus breathing in every part, has its vitality so intensified that it is, in proportion to its bulk, the strongest of created things—a living railway engine, or compared with which a railway engine is a baby's toy. Insects are proverbially of small dimensions. Their presence around us is only remarked as conferring additional life and gaiety on the landscape, and except when by some inordinate increase in their numbers, they make up by their multitude for their diminutive size, the ravages committed by them are trifling and insignificant. Far otherwise would it be if they attained to larger growth, and still possessed the extraordinary strength with which they are now so conspicuously gifted; they would then indeed become truly the tyrants of Creation—monsters such "as fables never feigned nor fear conceived," fully adequate to exterminate from the surface of the earth all that it contains of vegetable or of animal existence. A common flea or grasshopper will spring two hundred times the length of its own body, which is as though a man should at a single bound leap over the ball and cross of St. Paul's Cathedral. The dragon-fly possesses such indomitable strength of wing that, for a day together, it will sustain itself in the air and fly with equal facility and swiftness backwards or forwards, to the right or to the left, without turning. The beetles are encased in a dense and hard integument impervious to ordinary violence; and we may add that the wasp and the termite ant will penetrate, with their jaws, the hardest wood.

Neither is the velocity of the movements of insects inferior to their prodigious muscular power. It has been calculated that in its ordinary flight the common house-fly makes with its wings about six hundred strokes in a second of time, which will carry it a distance of five feet, but if alarmed its velocity can be increased six or seven times, or to thirty or thirty-five feet in a second. In this space of time the swiftest racehorse that ever trod the turf could clear only ninety feet, which is at the rate of more than a mile in a minute. Compare the infinite difference in the size of the two animals (ten millions of the fly would hardly counterpoise one racer), and how wonderful will the velocity of the little insect appear. Did the fly equal the racehorse in size, and retain its present powers in the ratio of its magnitude, it would traverse the globe with the rapidity of lightning.

Let the reader, therefore, imagine that great law of Nature which restricts the dimensions of an insect within certain bounds, dispensed with even in a single species. Suppose the wasp or the stag-beetle dilated to the bulk of a tiger or of an elephant, cased in impenetrable armour—furnished with jaws that would crush the solid trunk of an oak—winged and capable of flight so rapid as to render escape hopeless, what could resist such destroyers, or how could the world support their ravages?

Insects may, therefore, be regarded in the light of engines, so perfectly adapted to the work intrusted to them, that to increase or diminish their size would be to unfit them for the duties for which they are specially constructed, and as a necessary consequence, *no insect in its winged condition can be permitted to grow;* its growth must be effected under other circumstances, and generally under a form quite different from that which it presents in its perfect state —hence arises the necessity for **The Metamorphosis of Insects.**

Most insects in the course of their lives are sub-

ject to very great changes of form, attended by equally remarkably alterations in their habits and propensities. These transformations or *metamorphoses*, as they are called, quite as strange as any we read of in Ovid, might cause the same insect, at different ages, to be mistaken for three different animals. For example, a caterpillar, after feeding upon leaves till it is fully grown, retires into some place of concealment, throws off its caterpillar skin, and presents itself in an entirely different shape, wherein it has no power of moving about nor of taking food. In this, its second or chrysalis state, it seems to be lifeless, having neither a distinct head nor moveable limbs—after a lapse of time the chrysalis skin bursts open, and from the rent issues a butterfly, whose wings, soft and crumpled at first, soon extend and harden, and become fitted to bear away the insect in search of the honied juices of flowers. Hence there are three distinct periods in the

FIG. 77.—METAMORPHOSES OF BUTTERFLY.

life of an insect, more or less distinctly marked. In the first, or period of infancy, an insect is technically

called a *larva*, a word signifying a *mask*, because therein its future form is more or less masked or concealed. This name is equally applied to grubs, caterpillars, and maggots, and to all young insects before their wings begin to appear. Consequently, in this first period, which is much the longest portion of their lives, insects are always wingless, pass most of their time in eating, grow rapidly, and to allow of their growth, repeatedly cast off their skins.

During the second period, some insects retain their activity and their appetite for food, continue to grow and acquire the rudiments of wings; while others, at this age, entirely lose their larva form, take no food, and remain at rest in a death-like sleep. This is called the *pupa* * state of the insect, because in this condition they resemble an infant wrapped in swaddling bands. The pupæ from caterpillars are more commonly called *chrysalids*, because some of them, as the name implies, are gilt or adorned with golden spots, whereas pupæ, that retain their legs and capability of locomotion, are often named *nymphs*, the reason for which is not very obvious.

At the end of the second period insects again shed their skin, and come forth fully grown, and (with few exceptions) provided with wings. They thus enter upon their last or adult state, wherein they no longer increase in size, and during which they provide for their progeny. This period only lasts a short time, for most insects die immediately after they have laid their eggs. Bees, wasps, and ants, however, which live in society, and labour together for the common good, continue much longer in the adult state.

The innumerable races of insects may be classified in accordance with the following table:—

* Pupa, *a baby*. Those who have seen infants in many parts of the continent tied tight to a board, will appreciate the appropriateness of the expression.

INSECTS	Have three pairs of legs, and—	Undergo metamorphosis. Mouth formed for—	Mastication. Wings four; the two anterior—		In form of elytra; those of the second pair—	Folded only transversely . . .	COLEOPTERA.
						Folded in two directions or lengthwise only	ORTHOPTERA.
					Membranous and reticulated, like the posterior		NEUROPTERA.
			Suction wings—	Four .	All membranous, transparent, and divided into large cells. Mouth with distinct mandibles . . .		HYMENOPTERA.
					All covered by a kind of coloured dust. Mouth a spiral proboscis .		LEPIDOPTERA.
					The anterior ordinarily in the form of demi-elytra. Mouth a conical beak, either straight or curved. . . .		HEMIPTERA.
					Similar		HOMOPTERA.
				Two. .	Folded like a fan		STREPSIPTERA.
					Not folded		DIPTERA.
					Entirely wanting		APHANIPTERA.
		Are not subject to metamorphosis—	Have no wings. Abdomen—		Unprovided with leaping appendages		PARASITA.
					Provided with false legs or appendages for leaping		THYSANOURA.

Order Coleoptera.

The Coleopterous insects are characterized by having four wings, of which the anterior pair, always hard or leathery in their texture, form two strong shields, beneath which the hinder pair are lodged and protected. The front wings, or *elytra,** when in repose are always united by a straight edge, extending along their whole length. The hinder wings, which alone are adapted for flight, are much larger than the elytra, and when not in use, are folded transversely; in a few species they are wanting, and then the elytra are, as it were, soldered together. The tegumentary envelope of these insects is always remarkably hard, and forms a very substantial suit of armour; their mouth is constructed for the mastication of food, and is provided with a pair of strong mandibles, a pair of maxillæ bearing palpi, and a labium or lower lip, also bearing palpi. The abdomen is *sessile,* that is, is broadest at the place where it joins the thorax.

The metamorphosis which the Coleoptera undergo is complete. The larva resembles a worm; its body is soft, with the exception of the head, and the first segments of the body, which are of a horny consistence. They are generally furnished with three pairs of horny legs, attached to the three first rings, but sometimes these are replaced by fleshy tubercles. There is, however, never a greater number than six of these appendages. The pupa is motionless and takes no food, its limbs being swathed together by the external integument. It is generally enclosed in a shell or cocoon, composed of different substances, joined together by a viscid silky material; sometimes it is naked. This is by far the most numerous of all the insect orders; the number of species already known is probably not much less than fifty thousand. In order, therefore, more readily to arrange such a

* ἔλυτρον, elytron, *a case.*

multitude, they are divided into four sections, according to the number of joints or articulations entering into the composition of their feet (*tarsi*). The sections so formed are as follows :—

1. The **Pentamerans,*** in which the tarsi of all the legs are composed of *five* joints.

2. The **Heteromerans,†** in which the tarsi have *four joints on the two front pairs of legs, and five on the others.*

3. The **Tetramerans,‡** in which the tarsi of all the legs have *four* articulations.

4. The **Trimerans,§** in which all the tarsi have only *three* joints.

Section of Pentamerans.

The first division of Coleoptera, having five joints in all their tarsi, are the most active and highly gifted of the race, and may be considered as the lions and tigers of the insect world; they constitute the family of **Carnivora,‖** and are distinguished by having two palpi on each maxilla.

These beetles in their perfect state pursue and devour other insects; their larvæ also have similar habits. Among them we find

The **Tiger Beetles** (*Cicindela* ¶), which are excellent representatives of the quadruped whose name they bear; conspicuously the most rapacious and bloodthirsty of the race; equally remarkable for the beauty of their colours, their extreme activity, and savage propensities. They run with considerable swiftness, and take wing the moment they are approached; but they alight again at a short distance. They are commonly met with in the heat of summer upon heaths, and in other dry sunny situations. Their larvæ excavate cylindrical burrows in

* πέντε, pente, *five ;* μέρος, meros, *a joint.*
† ἕτερος, eteros, *various ;* μέρος, meros, *a joint.*
‡ τετρας, tetras, *four ;* and μέρος, meros, *a joint.*
§ τρεῖς, treis, *three ;* and μέρος, meros, *a joint.*
‖ Caro, carnis, *flesh ;* voro, *I eat.*
¶ Cicindela, *a shining insect.*

the ground, which are, many of them, upwards of a foot in depth: in the construction of these dens they exhibit extraordinary ingenuity, loosening the earth by means of their powerful jaws, and carrying it to the surface upon their broad heads. They have hooks upon their backs, which assist them in climbing to the top of their excavation, much in the same way as a chimney-sweep climbs a chimney. Their hole being completed, they station themselves just within its entrance, where they lie in wait for any poor passing insect traveller, which is instantly seized and dragged to the bottom of the cave, there to be devoured.

FIG. 78.—LARVA OF TIGER BEETLE.

The **Ground Beetles** (*Carabus*)* are scarcely less active than the foregoing, or less carnivorous in their habits; many of them are constantly employed in prowling about upon the surface of the ground in search of insect prey, lurking in the day time under stones and other similar places of concealment, and carrying on an unrelenting warfare against innumerable noxious insects, the destructiveness of which they materially assist in diminishing. Among these marauding beetles the most remarkable are

The **Bombardiers** (*Brachinus*), as they are not inappositely named, several species being provided with a means of defence unparalleled among the lower animals. Of all the inventions which mankind seems fairly entitled to claim as being exclusively of human contrivance, perhaps, that of guns and gunpowder might be deemed the most original, yet even in this, strange to say, he has been forestalled. The little bombardier beetles possessed an artillery of their own long before the fields of Crecy first trembled at the unaccustomed roar of human cannon, as any one will confess who may inadvertently lay hold of one of these living batteries. It is quite true that neither powder nor ball is needed by the insect cannonier; but there is the flash, the smoke, and the report, and although

"The far-hissing globe of death"

be wanting, its place is most efficiently supplied by a burning drop, so caustic in its nature as to be only comparable to nitric acid in its corrosive effects.

Sternly and unremittingly is the work of destruction, intrusted to these carnivorous beetles, carried on by night and by day without remorse or

* κάραβος, cárabos, *a beetle.*

respite, and were we to reflect for a moment, we should soon perceive how indispensable is their murderous zeal to the order and well-being of surrounding nature.

The active operations of these destroyers are not, however, restricted to the land. Many species are inhabitants of the water, and in that element have their assigned tasks to perform. Neither are their blood-thirsty propensities only manifested during their mature or winged state; from their earliest birth they are tutored to the work of destruction, and their very infancy is devoted to carnage and slaughter.

The **Water Beetles** (*Dyticus*) * exhibit, in a very striking manner, the facility with which, by a slight modification in their form and arrangements, the limbs of an insect become convertible to the most opposite uses. The body of the Dyticus, oval in its shape, and slightly flattened above and below, is converted into a boat so smooth and polished in every part, that it glides through the water with scarcely the slightest resistance, while the two hinder pairs of legs are changed into oars of a most effective and elegant construction. Thus limbed, the Dyticus is fully equipped for its piratical mode of life, and becomes an object of no little interest in the water over which it tyrannizes. Sometimes lurking beneath the weeds, it may be seen creeping stealthily about in search of some victim to seize by surprise; sometimes launching its skiff upon predatory excursions, the little corsair sweeps along by means of its oars with wonderful rapidity, coming every now and then to the surface of the water to breathe, and diving again into the depths below, carrying with it a supply of air beneath its wing covers to serve for respiration during its immersion.

FIG. 79.—WATER-BEETLE.

* δυτικός, dyticos, *diving*.

The young of these water beetles are as active and ferocious as the adult insects, although widely differing in point of form. These larvæ, not inappropriately distinguished by the name of "water tigers," have some resem-

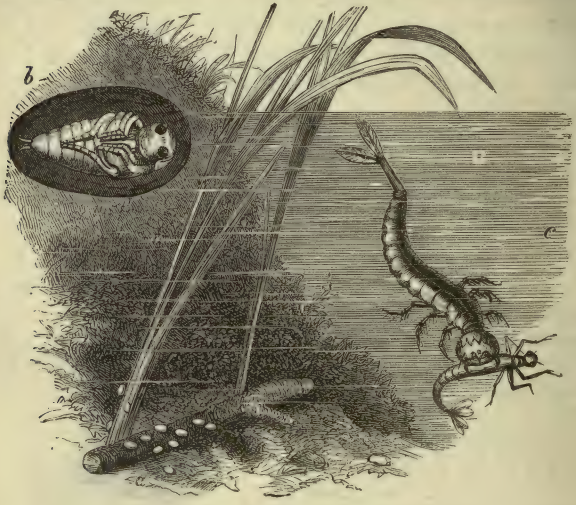


FIG. 80.—LARVA OF DYTICUS.

blance to a scolopendra, being composed of a succession of scaly rings, and they are, moreover, furnished with six strong and well-jointed legs, by means of which they run about with considerable rapidity. The head, which is attached to the body by a flexible neck, is broad, and composed of strong horny plates, adapted to support the formidable jaws, which are powerful hooked fangs, moving laterally, and so sharp that woe-betide the unfortunate creature upon which they lay hold. Thus armed, these butchers live upon other aquatic animals, upon which they rush with all the vivacity of a shark or pike, not sparing even individuals of their own species. After having several times cast their skin, these larvæ prepare to assume their pupa state; for that purpose, they creep out of the water, and bury themselves in the moist earth, in the vicinity of their native pond, each scooping out for itself an oval cavity wherein to pass the assigned time of helplessness and inactivity. (Fig. 80, *b*.)

Some naturalists are pleased to find in the rapacious race of beetles, the representatives of the eagles and the falcons among the feathered tribes—both are equally organized to combat and to kill—both strike at living game, and consequently must stand preeminent in strength and courage. But, as amongst the flesh-devouring birds, species exist possessing more ignoble attributes not formed for open battle, but content to appease their ravenous appetites with carrion and such offal; so among the insects numerous tribes exist, whose prey is garbage, and whose whole employment seems to be to search for and remove the dead remains of other animals. Everywhere these scavengers are busy; some frequent the muddy margins of our pools and ditches, eagerly in quest of rotten prey, others prefer the land, where they seek out with unremitting diligence whatever from decay begins to taint the air, while some, the very sextons of creation, bury whole the carcases they meet with, and thus vigorously assist in carrying out the sanitary laws of nature. To these scavengers belong

The **Brachelytrous* Pentamerans.** These have only one palpus on each maxilla; their wing-cases are much shorter than their bodies, which are generally narrow and elongated. They include

The **Rove Beetles** (*Staphilinus*), well known to every schoolboy by their turned-up tails and threatening jaws with which they menace their assailants. They generally take up their abode in the earth, in the vicinity of dunghills, or of rotten trees, or anywhere in the neighbourhood of rottenness and decay; they are all exceedingly voracious, run very quickly, and take flight upon the least alarm. Their bodies are generally jet black, and they diffuse an intolerable odour. The larvæ have the same habits as the perfect insects, from which, except from the circumstance that they have no wings, they are scarcely distinguishable.

The third section of Coleopterous Pentamerans

* *βραχύς*, brachus, *short*; *ἔλυτρον*, elutron, *wing-cover*.

are named **Serricornes.*** They are distinguished by the shape of their antennæ, which are very long and generally toothed like a saw. Among these are

The **Gold Beaters** (*Buprestis*) *, conspicuous from their size and the magnificence of their colours, which sometimes resemble polished gold, upon a field of emerald, or blaze with every tint of blue and green, purple and scarlet, mixed with metallic gleams of gorgeous brilliance. These beetles are all vegetable feeders; they walk slowly, but their flight is rapid, especially in hot and dry weather. When any one attempts to seize them they fall to the earth. A few small species may be met with on flowers, but they generally frequent forests and the vicinity of trees. The females lay their eggs in dead dry wood, in which the larvæ excavate long winding passages, wherein they undergo their metamorphoses.

The **Spring Beetles** (*Elater*)‡ are remarkable from their faculty of springing into the air when laid upon their backs, in which position, owing to the shortness of their legs, they would otherwise be completely unable to rise. The most celebrated among them is

The **Cucujo** (*Elater noctilucus*), which has upon each side of the back of its thorax a smooth convex round spot, from which at night there issues a light so brilliant that by its assistance it is easy to read the smallest print, more especially if several of these insects are put together in a glass vessel. By the light thus afforded, the Brazilian ladies are able to embroider; and not unfrequently they twine these living lamps among their hair to light them in their evening promenade. The Indians fasten them to their mocassins, and thus illuminate their path. An individual once accidentally brought one to Paris in some wood, wherein it had passed its larva state, and astonished the inhabitants of the Faubourg St. Antoine by a display of its brilliant light, an exhibition for which they were but little prepared. Nearly allied to these are

The **Glow-worms** (*Lampyris*),§ likewise distinguished by their capability of emitting phosphorescent light. The males of our common species are not particularly remarkable, but the females, which are without wings, are highly luminous. The light which they emit issues from the hinder part of their abdomen, and the insect can

* Serra, *a saw;* cornu, *a horn;* i.e. *antenna.*

† βούπρηστις, bouprestis, *an insect said to poison cattle.*

‡ ἐλατήρ, elater, *a leaper.*

§ λαμπυρίς, lampuris, *a glow-worm.*

vary its intensity at pleasure. This faculty of emitting light is one of the most puzzling circumstances in their history, nor is it easy to conjecture what end it serves. The suggestion frequently advanced, that its purpose is to guide the winged male to the apterous female in the darkness of the night, is by no means a satisfactory explanation : for, besides the fact that other nocturnal insects need no such aid, in many species of the genus both sexes are luminous, and both furnished with wings. The light of these foreign species (as for example, the lucciole of Italy and the fire-flies of North America) far surpasses the feeble glimmer of our own, and when the air is filled with myriads of them intersecting each other's path in every direction, the scene is one of indescribable beauty.

The **Death Watches** (*Ptinus*)* are a race of small insects, often formidable on account of the ravages they commit upon our property. Many species of this genus inhabit the interior of our houses, where, in their larva condition, they cause much damage by boring into wood. Nothing of a vegetable nature comes amiss to them—planks, rafters, beams, chairs, and tables, and even books, all fall a prey to their hungry industry; they bore them through and through with holes as sharply cut as if they had been drilled with the finest instruments. Some devote their special energies to farinaceous substances, and devour the very wafers in our desks : others, more formidable still to the naturalist, attack our collections of birds and insects, and commit sad havoc in our museums.

Fig. 81.—Death-watch beetle.

In some species both sexes, by way of calling their mates, are in the habit of rapping sharply and quickly with their mandibles upon the wood that they frequent, and replying to each other in the same manner. The noise thus produced, which somewhat resembles the ticking of a watch, has gained for them, from the ignorant and superstitious, the name of the "Death-watch," by which they are familiarly known.

The fourth section of *Coleopterous Pentamerans*

* πτηνός, ptenos, *winged.*

is distinguished by having the antennæ dilated towards their extremity or club-shaped, hence they have received the name of **Clavicornes.*** They all, in their larva condition, devour animal substances, but the perfect insects seem to indulge in a more general diet. They are the living dust-carts of creation, and nothing is too despicable or too offensive for their appetite. Among them we need only mention

The **Carrion Beetles** (*Silpha*),† which live exclusively on putrefying carrion, and

The **Sexton Beetles** (*Necrophorus*),‡ whose duty is to bury and get rid of anything that might pollute the air. Urged by a remarkable instinct, no sooner do they find the carcase of a bird, a mouse, a frog, a mole, or any other small animal, than they glide beneath it, and proceed to dig away the earth until they make a grave for its reception; having accomplished this, they lay their eggs upon the buried body, and covering up the little sepulchre depart. When the eggs are hatched, the larvæ, furnished with strong jaws, devour the carcase which supplies their food. When about to assume the nymph condition, they bury themselves still more deeply in the earth, and there construct a chamber lined with a tenacious slime, in which they undergo their final change.

Other tribes, still faithful to their duty, eagerly attack whatever they can find that is bereft of life.

The **Bacon Beetles** (*Dermestes lordarius*) even invade our larders to regale on rancid hams or bacon; furs, woollen stuffs, the skins of birds, the treasured specimens in our museums, all become their prey; they make no nice distinctions. What is dead they claim, and do not wait for man's permission.

The fifth section of *Coleopterous Pentamerans* includes the **Palpicornes**, which although nearly related to the preceding are principally aquatic in their habits.

* Clava, *a club*; cornu, *a horn*; i.e. *antenna*.

† σίλφη, silphe, *a black beetle*.

‡ νεκρός, necros, *dead body*; φόρος, phoros, *carrying*.

The **Large Water Beetles** (*Hydrophilus*)* belong to this group. They swim and fly equally well, but walk upon the ground with difficulty; their breast is armed with a sharp spine, a weapon that occasionally lacerates the hand of those that handle them incautiously. The females are provided with two spinnarets with which they form an oval cocoon, wherein their eggs are arranged with much regularity, packed up in a kind of white down. These cocoons may sometimes be observed floating upon ponds. Their larva differs widely in its structure from that of the Dyticus, with which these insects were long confounded; it is provided with a horny head, which it is able to turn back over its body, a faculty that permits it to use its back as a kind of table upon which it cracks the shells of little water-snails that constitute its usual food. In some species the females carry their eggs in a silken bag attached to their abdomen.

The sixth and last section of the *Coleopterous Pentamerans* is that of the **Lamellicornes**,† distinguished by having their antennæ terminated by a packet of narrow flat plates or lamellæ, arranged like the rays of a fan or the leaves of a book. They all live upon vegetable substances, and some are of large size—their bodies are massive, their flight slow, and their gait heavy and tortoise-like.

Their larvæ are so fat and clumsy that they are

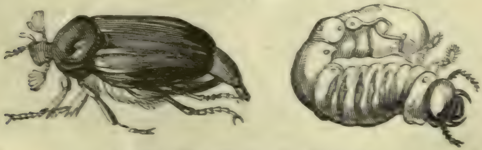


FIG. 82.—COCKCHAFER AND LARVA.

unable to walk, or do so with difficulty. They lie upon their sides and devour the vegetation that immediately surrounds them, and some of them live in this condition for three or four years. They pass their nymph condition buried in the earth, from which they slowly crawl when their metamorphosis

* ὕδωρ, udor, *water*; φίλος, philos, *loving*.

† Lamella, *a leaf*; cornu, *a horn*; or *antenna*.

is completed. We select one or two familiar examples as illustrative of the habits of this immense group.

The **Scavenger Beetles** (*Geotrupes*) are among the most useful insects met with in tropical climates: no sooner is the presence of filth announced by its scent, than the scavengers are heard coming booming up the wind, and roll it away at once in large pieces as big as billiard balls, and when they reach a place proper by its softness for the deposit of their eggs, and the safety of their young, they dig the soil out from beneath the ball, till they have quite let it down and covered it. They then lay their eggs within the mass. While the larvæ are growing, they devour the inside of the ball before coming above ground. These beetles, with their gigantic balls, look like Atlas with the world on his back, only they go backwards and with their heads down, push with their hind legs, as if a boy should roll a snow-ball with his legs while standing on his head.—Dr. Livingstone.

Fig. 83.—The Goliath Beetle, and Hercules Beetle.

The Lamellicorn beetles embrace some of the largest of the insect race, equally remarkable for

their size and prodigious strength,—hence such names as Goliath, Hercules, Sampson, &c., are pretty freely conferred upon them.

We now arrive at the second great section of the Coleoptera—namely, the **Heteromerans**—distinguished by having five joints on the tarsi of each of the two front pairs of legs, but only four on the two hind ones. They are all, without exception, vegetable feeders; and it may be said that every plant has appropriate inhabitants selected from their numerous hosts.

First of this extensive series we must notice the **Melasomes,*** remarkable as a group from the circumstance of their bodies being almost invariably black, and thus adapted to the nocturnal habits of the generality of the species. Many of them are wingless. Others, provided with wings, are frequently met with, especially towards night, in unfrequented parts of our houses; they abound in bakers' shops, corn-mills, and wherever farinaceous food is obtainable; they are likewise frequently to be met with in old walls, and in other out of the way situations. As a sample of the group we may mention

The **Meal Grinders** (*Tenebrio molitor*), whose larvæ, under the name of meal-worms, are found abundantly in bran and flour, which they devour in great quantities, and wherein they undergo their metamorphosis. These grubs being easily obtainable, are given as food to nightingales and other small birds.

A second numerous family is that of the **Taxicornes,†** so called from the regularly beaded structure of their antennæ. These are generally found upon decaying fungi, such as grow upon old trees, or else they lurk beneath the bark, while others live upon the ground or under stones.

The **Stenelytra‡** form the next division. Many

* μέλας, melas, *black*; σῶμα, soma, *body*.

† τάξις, taxis, *regularity*; cornu, *a horn*, or *antennæ*.

‡ στενός, stenos, *narrow*; ἔλυτρον, elutron, *wing-cover*.

of these inhabit trees, creeping beneath the bark, where, too, their progeny is reared, while some are only found on flowers, or are appropriate to different kinds of fungi or of mushrooms.

The **Trachelides,*** distinguished by the length and size of their necks, are likewise found on plants, of which they eat the leaves or suck the nectar from their flower-bells; many of them are remarkable for shamming death as soon as they are seized or feel themselves to be subjects of observation. Hundreds of these are seen in summer time in every garden, known by their thin elytra, slender limbs, and pretty tints, to be the fit concomitants of flowers. Among the most remarkable examples of the group are

The **Blister Beetles** (*Cantharis*), valuable from their great utility in medicine. These little insects, as is well known, contain a peculiar irritating matter, which when applied to the human skin has the property of producing a blister. They are of a golden green colour, and are very common in France, Italy, Spain, and Russia, where they feed upon the leaves of the ash, the lily, and the privet. The "Potato Fly" (*Cantharis vittata*) is an American species, which possesses qualities similar to the European, for which it forms an efficient substitute.

FIG. 84.—BLISTER BEETLE.

COLEOPTEROUS TETRAMERANS.

The third great section of the Coleoptera includes all those beetles that have only four joints in the tarsi of all their legs. It embraces an immense host, which, however, have the following characters in common. They all live upon vegetable substances. Their larvæ have very short legs, or in some instances legs are entirely wanting, their place being

* τράχηλος, tráchelos, *the neck.*

supplied by little fleshy tubercles. The perfect insect frequents the flowers or leaves of plants. First and most conspicuous among this extensive group are

The **Snout Beetles** (*Rhyncophora*),* at once recognisable by the shape of their head, which is prolonged into a sort of snout or proboscis, upon which are placed the antennæ. Their larvæ resemble soft little white worms, furnished with a scaly head, but quite destitute of legs. They all devour the different parts of vegetables, and some are found only in the interior of fruits or seeds, by destroying which they do immense damage. Their nymphs are enclosed in a cocoon. But even in their perfect state some of these beetles are very destructive when they are at all numerous.

FIG. 85.—COPPER-COLOURED WEEVIL.

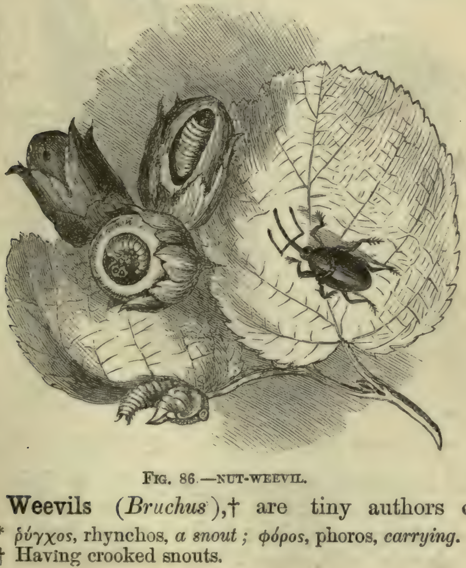


FIG. 86.—NUT-WEEVIL.

The **Weevils** (*Bruchus*),† are tiny authors of in-

* ῥύγχος, rhynchos, *a snout ;* φόρος, phoros, *carrying.*
† Having crooked snouts.

calculable damage. The females deposit their eggs in the buds, yet young and tender, of our most useful vegetables, in nascent grains of corn, in the flowers of the palm-tree and the coffee-plant. In such situations the larvæ are hatched, and find abundant food stored up around them. Having completed their metamorphoses, the perfect insects eat their way out of their vegetable prison, leaving behind them those round holes so often seen in peas or grains of wheat. One well-known species only lives in nuts, where it devours the kernel, converting the interior into a mass of bitterness. Another lives in cork, filling the galleries which it excavates with an equally bitter substance, and this it is which gives the bitter disagreeable flavour to "corked" wine. Many species, such as

The **Diamond Beetles** (*Curculio*), are gorgeously apparelled, as is abundantly indicated by the names by which they are designated. "Imperial," "royal," "sumptuous"

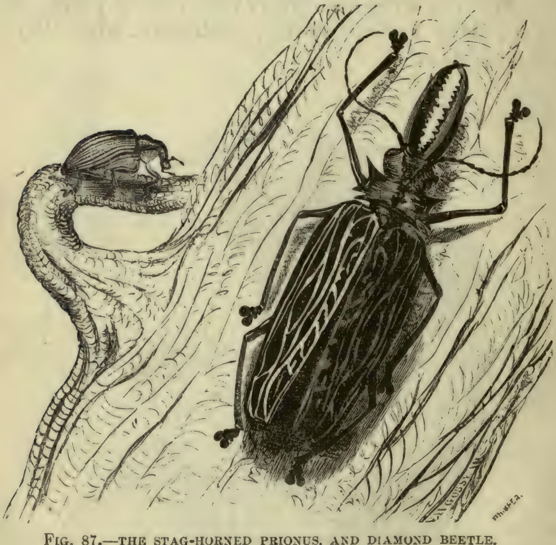


FIG. 87.—THE STAG-HORNED PRIONUS, AND DIAMOND BEETLE.

are the humblest epithets appropriate to their magnificence. Diamonds and pearls, emeralds and rubies, gold and sparkling gems, look paltry when compared with their elaborate bedizenment. In the Brazils, the mimosa

trees are sometimes so crowded with these splendid insects that the branches bend beneath their glittering burden. Even some of our native species, such as the *Rose curculio* when seen under a microscope, are found to be most brilliantly decorated.

A second section of *Coleopterous Trimerans* comprehends

The **Wood Eaters** or **Xylophagi**,* a race of insects specially appointed to devour timber. They mostly live upon wood, in which their larvæ excavate galleries in all directions, so that when they become numerous, whole forests of pine and fir are destroyed by their ravages; some cause immense damage amongst olive-trees, whilst others, the feeblest of the race, content themselves with devouring various kinds of fungi.

As an example of these timber borers, we give a figure of

The **Long-horned Beetle** (*Prionus*), one of the largest of the tribe, conspicuous alike from the beauty of its colours and the strength of its jaws. (Fig. 87.)

In the last section of the Coleoptera, the

Trimerans, the number of tarsal joints in all the six legs is reduced to three; of these the best known examples are

The **Lady-birds** (*Coccinella*), universal favourites, and as useful as they are pretty. These insects are readily recognised by their semi-globular shape, and by the peculiar pattern of their colouring, generally black spots upon a red or yellow ground, or red and yellow spots upon a black ground. They feed exclusively upon the plant-lice or Aphides that infest the choicest flowers of our greenhouses, and are still more hurtful in the hop-plantation and the garden. To the destruction of these insect pests the whole energies of the Lady-bird are devoted. Its eggs are laid in little patches on the leaves of plants, resembling groups of nine-pins set upright; when these are hatched they give birth to a larva furnished with a small head and a thick but tapering body, which creeps actively about the

* ξύλον, xylon, *wood;* φαγεῖν, phagein, *to eat.*

leaf by means of six short legs attached to its anterior segments. (Fig. 88.) Its colour is usually a dark bluish-gray, having black spots interspersed with a few orange spots of larger size. It riots among the Aphides like a lion among a flock of sheep, devouring them one after another with insatiable appetite, until its full growth is accomplished; it then glues the hinder part of its body to a leaf, and awaits its change into a pupa. In a day or two, the skin cleaves down the back, and the pupa shows itself: it is of a white colour at first, but soon becomes black, spotted with red and yellow. It does not at once quit the spot to which it had adhered as a larva, but remains there with its old skin gathered in folds around its hinder parts. For a week it continues in this state, motionless and apparently dead, but really carrying on within an important process, namely, developing and hardening the various organs that belong to the perfect insect. At the end of that time the pupa-case bursts, and the Lady-bird crawls out with its wing-cases small and crumpled; but they soon enlarge and become smooth and shapely, though they remain for a time of a pale yellow colour, without any trace of the spots that afterwards become so beautiful. In the course of a few hours, however, the rich colours begin to appear, and the various distinctive marks give the creature its character and elegant appearance. At the same time its skin has acquired firmness and its muscles vigour, so that leaving its cast-off garments behind, it departs on its fresh travels, again to make war on the Aphides, and to choose a mate.

FIG. 88.—LADY-BIRD IN ITS STAGES.

ORTHOPTERA.*

The **Orthoptera** differ from the beetles in the following circumstances. Their tegumentary skeleton is less dense and solid, their front wings or *elytra* are semi-membranous, and are supported by a framework of nervures; moreover, instead of meeting in a straight line along the back, they overlap each other. The hind wings are folded longitudinally like a fan. The larvæ and pupæ are equally active; the former possess no wings, and in the latter these organs only begin to show themselves enclosed in wing-cases; in both conditions they closely resemble the perfect insect, and live upon the same food. Their mouth is always furnished with cutting mandibles, with which they devour vegetable substances. They are all terrestrial in their habits, and for the most part feed upon plants. The entire class may be conveniently divided into two groups.

1st. Those which run upon the ground (**Cursoria**).†

2nd. Those whose hind legs are constructed for leaping (**Saltatoria**).‡

The first division is represented by the Earwigs and Cockroaches, the latter by the Grasshoppers and Crickets.

The **Earwigs** (*Forficula*) form a connecting link between the Orthoptera and the Beetles, and are sometimes described as forming a class by themselves, under the names of **Dermaptera** § and **Euplexoptera**; ‖ the latter name is given to them on account of the beautiful manner in which their hinder wings are folded up when at rest under their elytra. The appearance of these elegant wings, when expanded, is represented in the annexed figure (Fig. 89); when closed they are curiously packed into a sixth part of their ample breadth. These insects do much

* *ὀρθός*, orthos, *straight*; πτερόν, pteron, *wing*.
† Cursoria, *running*.
‡ Saltatoria, *leaping*.
§ *δέρμα*, derma, *skin*; πτερον, pteron, *wing*.
‖ *ἓυ*, eu, *beautiful*; πλέκω, pleco, *I plait*; πτέρον, pteron, *a wing*.

injury in our gardens, by devouring the fruit and destroying the petals of our favourite flowers. They manifest great care and attention towards their young, guarding them with parental instinct, and defending them by means of the powerful forceps appended to the hinder part of their body.

FIG. 89.—EARWIG ON THE WING.

The **Cockroaches** (*Blatta*), supposed to have been originally imported from Asia, now swarm in this country, especially in the underground kitchens of London and other large cities. They devour all kinds of provisions, and even gnaw flannels, shoes, and other animal substances. They are nocturnal in their habits, coming out of their holes after all has become dark and quiet, and sometimes in such numbers that, if a candle be suddenly brought into the room, the floor will appear quite black with these annoying intruders, yet in a few moments all of them disappear. The eggs of these insects are enclosed in an egg-case of very curious structure, which is frequently to be met with in the crevices of walls, behind shutters, and in similar places of concealment; this box the female carries about with her for some time attached to her body, but at length she fixes it to the selected spot by means of a sort of gummy cement.

The **Leaf Insects** (*Mantis*) are the most remarkable of the Cursorial Orthoptera. No Parisian manufacturer of artificial flowers could more successfully imitate the productions of Flora, than these insects are made to counterfeit the branches and the foliage of the shrubs they frequent, so that while in their natural haunts, it is next to impossible for the most practised eye to distinguish them. The appearance of the leaf insects whilst waiting for their prey is very singular. They remain for hours together stationary in the attitude represented in the annexed figure with their fore legs held up together like a pair of arms, prepared to seize any insect that may come within their reach. Hence they have obtained a sort of sacred character amongst the credulous inhabitants of the countries in which they are found, who from a superstitious notion, that while in that attitude they are

engaged in prayer, have given them such names as Prega Diou, Prie Dieu, &c. These creatures are very voracious.

FIG. 90.—MANTIS.

No sooner does an insect come near them, than like a cat approaching a mouse, the mantis moves imperceptibly along, and steals towards its victim, fearful of putting it to flight. When sufficiently close, the fore leg is extended to its full length, and the fly is seized and crushed by the numerous spines with which its edges are armed.

The **Leaping Orthoptera** (*Saltatoria*) are at once recognisable by the great size and strength of their hind legs, a structure whereby they are enabled to perform prodigious leaps. Of their general form, we have a familiar example in the house-cricket, everywhere to be met with.

The **House-cricket** (*Gryllus domesticus*) frequents the same situations, is active at the same season, feeds on the

same substances, and has, in many respects, the same habits as the Cockroach. Its ringing "crink" proceeding from the fireplace is considered a cheerful sound, and probably, from its association with genial warmth and plenty, is often enumerated among the amenities of the fireside.

The shrill sound, above alluded to, is produced only by the male rubbing its wings, which are peculiarly constructed, one against the other.

The **Grasshoppers** (*Gryllus campestris*) make use of their hind legs in producing their "crink." The thigh is furnished with a number of transverse, overlapping, angular plates, and the shank carries a series of short horny points upon each side. The insect when it crinks, brings the shank up to the thigh, and rubs both to and fro against the wing-sheaths, doing this by turns with the right and left legs, which causes the regular break in the sound.

The **Locusts** (*Gryllus locusta*) belong to the same

FIG. 91.—LOCUSTS.

family as the cricket and grasshopper, and, considered

individually, are quite as harmless, but coming, as they frequently do in Eastern countries, in hosts, which darken the air and cover the surface of the earth, are amongst the most dreadful scourges of the human race.

Dr. Shaw, who has given us an account of the swarms which he saw in Barbary, tells us that they first appeared about the end of March, and increased into vast numbers in April, but returned into the extensive plains in May to deposit their eggs. The larvæ derived from these eggs made their appearance in June, and were formed into compact bodies, each brood covering a square furlong of ground; they marched onward in a phalanx, surmounting every obstacle in their way, entering houses and chambers, and desolating the gardens, undeterred by the slaughter made amongst the foremost. In this manner horde succeeded horde, for days together. In about the course of a month they arrived at their full growth, and cast their pupa or nymph-skin, and as soon as their wings were dry and expanded, mounted into the air. Locusts are eaten in many places. They are mentioned as among the clean meats in Lev. xi. 22. In the plain of Bushire, they are collected, dried, and salted, and sold to the peasantry; when boiled the yellow ones turn red, and eat like stale shrimps. The Arabs grind them into powder, which they make into small round cakes, which serve for food when bread is scarce. In the Mahratta country the people salt and eat them. They are eaten by the Hottentots, and formed in ancient times part of the diet of the Ethiopians and Parthians.

The **Mole-cricket** (*Gryllotalpa*) is a burrower, not inferior to the mole, after which it is named, in the singular adaptation of its structure to the habits assigned to it. Like that animal, it has the fore limbs shortened, flattened, and enormously strengthened, while their extremities are formed into broad limbs turned obliquely outwards, and armed with stout tooth-like projections. By the assistance of this most efficient apparatus, the mole-cricket makes its way beneath the soil with the utmost facility, and at the proper season digs for itself a little chamber in the earth, with smoothly-polished walls, in which it deposits from a hundred to three hundred eggs, in their shape much like little sugar-plums. Intricate winding passages lead from this retreat to the surface of

the bank, at the mouth of one of which the old cricket sits and chirps cheerfully all the day long.

FIG. 92—MOLE-CRICKET.

ORDER NEUROPTERA.*

The insects belonging to the **Neuropterous** Order possess four transparent wings, for the most part of equal size. The nervures are numerous and connected, so as to form a net-work pattern more or less close. The mouth is armed with jaws, but the body is not furnished with a sting. The larvæ are active, and always provided with six jointed legs, each terminated by a pair of hooks.

The **Dragon Flies** (*Libellula*). The brilliant dragon flies that career on flashing wing through the lanes and over the ponds in the warmest weather of summer, give us the highest idea of insect power, combined with elegance of form. Their large round lustrous eyes, both furnished with twelve thousand polished lenses, that command each point on the whole sphere of sky or earth; their bur-

* *νεῦρον*, neuron, *nervure*; *πτέρον*, pteron, *a wing*.

nished armour, gemmed with green and gold and black; their gorgeous wings, like films of living glass stretched over net-work (to compare with which, the finest lace is but a sorry piece of workmanship), proclaim them tyrants

FIG. 93.—DRAGON-FLY.

of the air, and monarchs of the insect world. Yet in the earlier stages of their existence, these splendid creatures arrayed in humbler guise inhabited some neighbouring pool or ditch; the larva is an uncouth, broad, flat, olive-coloured animal, having six sprawling legs with which it crawls, spider-like, about the mud at the bottom of ponds, or glides by a singular mechanism through the water. The hinder extremity of the body is furnished with several leaf-like appendages, capable of being brought close together or opened at pleasure. These close the orifice of a cavity whose sides are very muscular. When the insect wishes to move rapidly it opens this cavity, which thus becomes filled with water, and then by a contraction of its walls the water is forcibly ejected in a stream, as from a syringe, and thus the larva is propelled through the water with its legs closely packed against its sides. The pupa only differs from the larva by having the rudiments of wings attached to its thorax; both are

active and voracious, the tyrants of the pool, devouring with ferocity other insects, tadpoles, small newts, and even fishes. These predatory habits are continued in the perfect insect, whose sanguinary propensities are no less correctly expressed by our term *Dragon-fly*, than its elegance and grace by the French appellation *Demoiselle.* It pursues gnats and flies in the air, eating them on the wing. It has been seen to catch butterflies, and Mr. Gosse, to whose elegant pen we are indebted for much of the above graphic account of their history, believes that they sometimes pounce upon the fry of fishes when swimming at the surface.

FIG. 94.—PUPA OF DRAGON-FLY.

The **May Flies** (*Ephemera*)*. These insects have re-

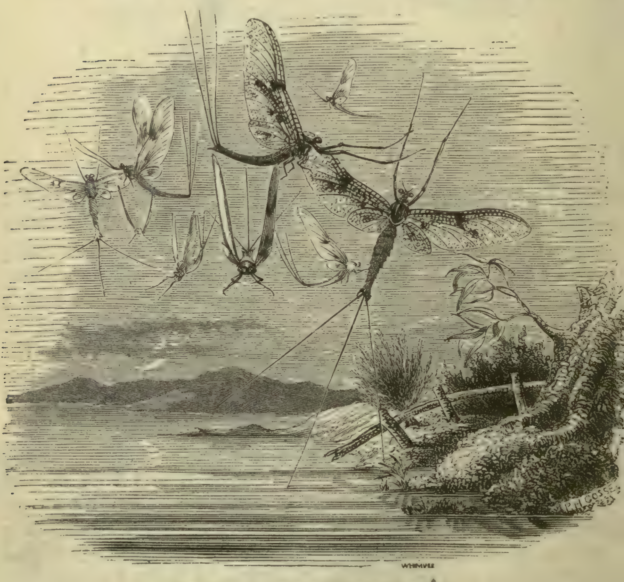


FIG. 95.—MAY-FLIES IN SUNSET DANCE.

* ἐφήμερος, ephemeros, *living but a day.*

ceived their name from the shortness of their existence in their perfect state, which is, indeed. so brief that the same evening sun which sees their birth generally witnesses their destruction. Their life, however, in the earlier stages of their growth is of much longer duration. In their larva state they live in the water, lurking under stones, or residing in little holes that they excavate in the banks of the stream. When about to undergo their last transformation, they leave the water and cast off their pupa covering,

FIG. 96.—LARVA OF EPHEMERON, AND SECTION OF ITS CELL.

but by a remarkable exception to other insects, they are still covered by a thin pellicle, which gives them a dull appearance. In this condition they are known to the angler as "*duns*;" in a short time, however, they cast off this temporary *deshabille*, leaving it upon trees or walls, or even the clothes of the passer-by, and present themselves in the full livery of the perfect insect, in which garb they constitute the "*Drake*" of the fly-fisher.

The **Scorpion Flies** (*Panorpa*), are remarkable from the extraordinary structure of the tail, which in the male is terminated by a pair of forceps, giving them the appearance of winged scorpions.

The **Ant Lions** (*Myrmeleo*)* much resemble the dragon flies, but their habits in the earlier stages of their existence are very different. The larva lives principally upon ants, which it catches by a singular contrivance. Not being able, from the structure of its body, to catch such active prey by any ordinary proceeding, it constructs a trap, by walking backwards, round and round and round, until a deep conical excavation is formed in the loose sand, at the bottom of which the creature buries itself, and there remains quietly concealed, with the exception of its long scissor-like fangs, which are kept half open and ready for action. Thus ensconced, woe betide any im-

* μύρμηξ, murmex, *the ant;* λέων, leon, *the lion.*

prudent insect that unhappily passes too near the treacherous margin of his pit-fall. No sooner does it approach

FIG. 97.—CIRCULAR DITCH OF ANT LION.

the fatal brink than, the loose sides giving way beneath its feet, it is precipitated to the bottom, and falls at once into the power of its destroyer. The Ant-lion, or as Bonnet calls him, on account of his cunning, the "Ant-fox," has no mouth, but instead, two horny fangs, resembling jaws, which are toothed upon the inner margin, and terminate in sharp points. These jaw-like appendages are hollow, and serve not only for seizing, but for sucking the juices of any insect that may come within reach.

FIG. 98.—LACE-WINGED FLY—MANNER OF DEPOSITING EGGS.

The **Lace-winged Flies** (*Hemerobius*)* are not very dissimilar from the ant-lions, although they dig no pit-falls. These insects, frequently seen in our gardens, with their bright green bodies, golden eyes, and iridescent wings, are in their perfect state most elegant creatures. The female lays her eggs upon the leaves of plants, to which they are attached in a very curious manner. The insect first fixes to the leaf a small quantity of a tenacious gum-

* ἡμέρα, emera, *day*; βίοω, bioo, *to live.*

like fluid, sufficiently viscid to be drawn out into a long thread-like filament, upon the farthest end of which the egg is attached, so that when the filaments are hardened by exposure to the air, each egg is suspended at the extremity of a slender foot-stalk. The larvæ hatched from these eggs have been named "Aphis-lions," for no sooner do they get on to the plants, then they attack the aphides with insatiable voracity, and are thus of incalculable benefit to the gardener. Some of them cover their bodies with the skins of their victims, so as to render themselves almost invisible. When full fed, they spin themselves cocoons, and thus await their final change.

FIG. 99.—APHIS-LION.

The **Stone Flies** (*Semblis*) are among the favourite lures of the fly-fisher. These insects lay their eggs upon the rushes by the river-side, placing them perpendicularly on end, like nine-pins, glued together. The larva inhabits the water, where it breathes by means of gill-like filaments attached to the side of its body.

The **White Ants** (*Termes*). These destructive insects have no relationship whatever with the ants properly so called. They abound in all tropical countries, where, whilst in their larva condition, they commit terrible ravages. Their larvæ, called also workers or labourers, very much resemble the perfect insects, but their bodies are softer, they have no wings, and their head, which seems proportionately of larger size, is not furnished with eyes, or if they exist at all, they are extremely minute. These insects congregate together in societies so numerous as to defy calculation. They live together, either concealed underground, or they take up their abode in anything that is made of wood, no matter what,—trees, planks, and beams; even articles of furniture are made

FIG. 100.—WORKER TERMITE.

available for their habitations. In these they excavate

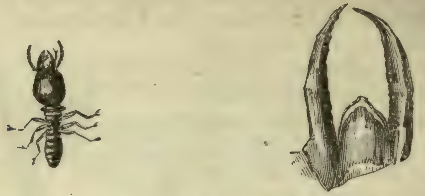


FIG. 101.—SOLDIER TERMITE, AND JAWS OF THE SAME MAGNIFIED.

galleries in every direction, never, however, injuring the surface, so that although objects so attacked continue to

FIG. 102.—SECTION OF NEST OF TERMES BELLICOSUS.

look substantial externally, they fall to pieces at the slightest touch. If compelled to leave their domicile, they con-

struct tubes or covered ways, wherein they go, so that they

FIG. 103.—MALE TERMITE.

always work concealed from observation. Sometimes they raise edifices above the ground in the shape of pyramids or towers, occasionally surmounted by a solid roof: these habitations, both from their dimensions and their numbers, might easily be mistaken for villages. Besides the *labourers*, each community contains a number of individuals called *neuters*, or soldiers, to whom the defence of the colony is intrusted; these are at once distinguishable from the large size of their heads and ponderous jaws. Besides the above, there are winged males, and a queen or fertile female, whose fecundity surpasses anything elsewhere known in the animal creation. Arrived at their perfect state they all become possessed of wings, and issuing forth, in countless multitudes by night, cover the country as with a living deluge. The rising sun, however, dries their wings, and they become a prey to numerous enemies, to whom they serve as food.

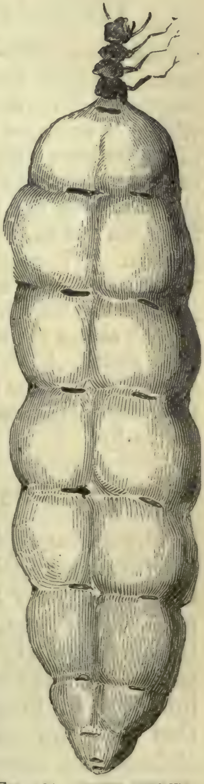


FIG. 104.—QUEEN TERMITE (NATURAL SIZE).

The **Caddis Flies** (*Phryganea*),* which, like the May-flies, are among the best friends of the fly-fisher, are usually placed among the Neuropterous insects, although the nervures of their wings can scarcely be said

* *φρίγανον*, phryganon, *a dry stick.*

to form a net-work.* Their economy in the early stages of their growth is very curious. The larva, which is not

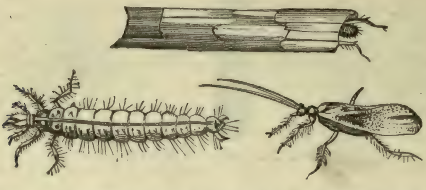


FIG. 105.—PUPA CASE, LARVA, AND FLY OF CADDIS-WORM.

unlike a caterpillar, forms for its residence a tubular case, made of minute shells, stones, seeds, bits of stick or bark, fragments of the stems of water-plants, and similar matters, which it arranges around its body, fixing them by means of a glutinous silk, which also lines the tube. Numbers of these cases may often be seen at the bottom of pebbly streams, with the head and feet of the larva protruding from one end as it crawls about, with a straggling irregular motion. When full grown, the little creature creeps up the stem of some aquatic plant till the mouth of its case just reaches the surface of the water; it then spins a net of silk across the entrance to its abodè, and goes into the pupa state. At the appointed time the pupa tears its way easily through the silken grate, crawls a few inches out of the water, throws off its pupa skin, and becomes a winged caddis-fly.

ORDER HYMENOPTERA.†

The Hymenopterous insects, like the Neuroptera, are furnished with four transparent wings, but instead of the nervures forming a close net-work, they are much more sparingly distributed. Another difference is that in the Hymenoptera the hind pair of wings seem as if cut out of the front pair, with which they interlock by means of small hooks during flight, so that the two wings almost resemble one. The abdomen is, moreover, terminated by an apparatus,

* Some authors constitute a distinct order for them, under the name of **Trichoptera**, or Hairy-winged insects.

† *ὑμήν*, umen, *a membrane; πτέρον*, pteron, *a wing.*

which in some species serves for the deposition of the eggs, but in others is connected with a poison-bag, and forms a venomous sting. To this Order belong

The **Saw Flies** (*Tenthredo*). They derive their name from a curiously-constructed instrument called an ovipositor, with which the female is provided. This consists of a saw composed of two blades that work alternately, by means of which she makes incisions in the branches of plants, wherein she deposits her eggs. The wounds thus made by the teeth of the saw frequently cause the plant to swell into a fleshy mass resembling a

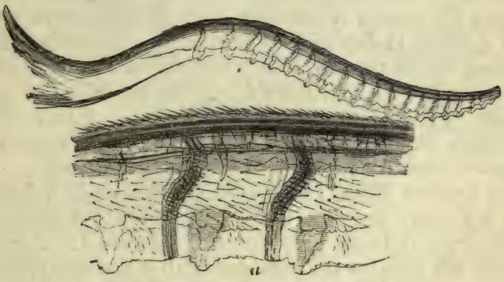


FIG. 106.—SAW OF SAW FLY.

small fruit, in the interior of which the larvæ find the materials for their subsistence. The larvæ very much resemble caterpillars, from which, however, they are easily distinguished by the number of their feet; before changing into nymphs, the *false caterpillars* enclose themselves in a cocoon, in which they remain many months in their caterpillar condition, only becoming changed into nymphs a few days before their final conversion into Saw flies.

In the spring-time of the year, when the bright leaves of our gooseberry-bushes first make their appearance, they are often devoured in a remarkable manner, even before they have completely concealed the straggling spiny branches. If the injury stopped here, with the despoliation of his gooseberry-bushes, the gardener might perhaps put up with it without much grumbling; but unfortunately the production of leaves and fruit are intimately connected, and unless the branches are well clothed with the former, the crop of the latter will be very small. If we search

for the cause of this wholesale destruction, we shall find that it is occasioned by a multitude of small caterpillar-like larvæ, furnished with twenty feet, of a pale-greenish colour, covered with numerous rows of little black tubercles, each of which bears a small hair at its summit; sometimes a thousand or more will inhabit a single bush, which is of course soon stripped of every green leaf; in about ten days these voracious larvæ have attained their full growth, when they descend into the ground beneath the scene of their ravages, enclose themselves in a small cocoon, and undergo their transformation into a pupa. In this condition they remain for a fortnight, when they emerge in the perfect state. The fly thus produced is a little Saw-fly (*Nematus Grossulariæ*), which in its turn becomes the parent of another host of destructive gooseberry grubs. It deposits its eggs along the course of the principal veins, on the lower surface of the leaf, where they are placed like rows of minute beads. The pupæ proceeding from this second brood pass the winter in the earth, and the perfect insects do not emerge from them before the month of March in the following year.

The **Cuckoo Flies** (*Ichneumon*) are so called because they lay their eggs in the interior of other insects, at whose expense their progeny are nourished. For this purpose the females are provided with a boring apparatus, somewhat resembling a long tail, called their ovipositor, by means of which they implant their eggs in the backs of their victims, just as a gardener would set potatoes in the ground. The female, when about to lay her eggs, may be seen flying about with restless industry in search of the larvæ or pupæ of other insects, or even spiders, to which she is about to intrust the support of her family. No matter where they are hidden, under the bark of trees, or in cracks and crevices, she is sure to find them out, and soon succeeds by means of her long ovipositor in piercing their flesh, and depositing an egg in the interior of their bodies, and occasionally she repeats the operation several times. In process of time the eggs are hatched, and the larvæ of the Ichneumons find abundant food in their strange domicile. By this proceeding the hungry but sterile caterpillars are prevented from changing into the prolific butterfly, and thus the world is defended against their insatiable voracity.

The **Gall Flies** (*Cynips*). These insects, too, are fur-

nished with a borer, or ovipositor, but of a different character—by its assistance the little Cynips bores the leaves or tender shoots of trees, in which she lays her eggs—the wounded part, strangely responsive to such a stimulus, swells out into an excrescence—that is called a *gall*. The

FIG. 107.—GALL FLY.

form and the solidity of these vegetable productions varies according to the part of the plant which produces it. The leaves, the buds, the petioles, the bark, the roots, all form their different kinds, some of which are useful in the arts. The gall-nut of the oak, for instance, yields a deep black dye, and is employed in making ink. The larvæ hatched within these galls find there both board and lodging, till the time arrives for their last change.

In the second section of the Hymenopterous Insects, the females, instead of an ovipositor, are furnished with a sting. This section embraces

The **Ants** (*Formica*), so celebrated for their foresight and their industry. These insects live in societies that are often very numerous, and consist of individuals of three different denominations—the *males*, the *females*, and the

neuters, which last are only females imperfectly developed; and it is upon them that the work of the colony and the care of the young entirely devolves. The nature and form of the abode of these insects varies in accordance with the instincts of the species; some establish themselves under ground, others build edifices of considerable height, surmounted by dome-shaped roofs, others again reside in aged trees, the interior of which they pierce in all directions with their galleries, which, however irregular they may seem, always lead to the nurseries of the establishment. The labours of the industrious neuters are very multifarious; some go in search of provisions, in the transport of which they mutually assist each other; some feed the young, take them out on fine days to enjoy

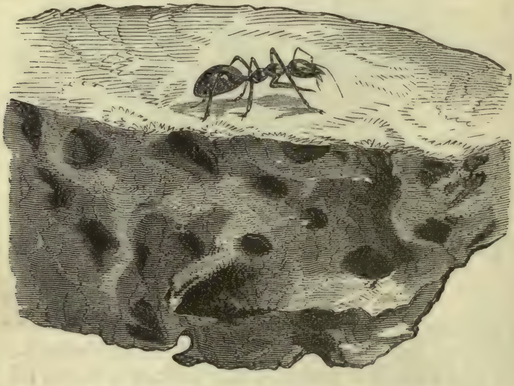


FIG. 108.—WORKING ANT AND PORTION OF ANT HILL.

the sunshine, and watch over them with the tenderest care, exhibiting in their defence a degree of courage well calculated to excite admiration. When their habitations are by any means injured or destroyed, no time is lost in useless despair, one spirit animates each individual, simultaneously they set to work to repair their misfortune; they labour unceasingly, nothing damps their ardour, or abates their industry until, as if by magic, their habitation rises to its former height and beauty, and all traces of ruin have disappeared.

The **Wasps** (*Vespa*) likewise live in society. Only the females found new colonies. In the spring they lay

their eggs, from which are derived individuals called *workers*, who assist their common mother. To construct their nest or vespiary, these insects, by the aid of their mandibles, detach pieces of bark or old wood, which they reduce to a sort of paper-like paste. Of this they form the combs: these are generally horizontal, suspended by pedicles, and composed of hexagonal cells, serving for the lodgment of the larvæ and pupæ. The combs are ranged in stages parallel to each other at regular distances, and are joined together at intervals by little columns that support them. The whole is built sometimes in the open air, sometimes in the hollow of a tree, and some are enclosed in a common envelope, according to the species. It is only in the beginning of autumn that male wasps are found in the vespiary; the young females make their appearance at the same time. About the month of November, the young wasps that have not completed their last metamorphosis, are put to death, and thrown out of the cells by the neuters, who, as well as the males, perish when cold weather arrives; so that the preservation of the species is confided exclusively to the few females who resist the inclemency of the winter, and survive till spring.

The **Bees** (*Apis*). A society of bees consists of individuals of three different kinds; namely, the "workers," or "labourers," the *drones*, and one solitary fertile female called the queen-bee. The workers are very numerous. In a well-populated hive their average number is from fifteen to twenty thousand. They are of smaller size than the drones; from which they are moreover distinguishable by their spoon-shaped mandibles, and by the structure of their hind legs, which are furnished with excavations upon their outer surface surrounded by hairs called "baskets," in which they convey the pollen of flowers collected in the gar-

FIG. 109.—FESTOON OF WAX-MAKERS.

den. The *males*, or *drones*, when at their full complement, number from six to eight hundred in a hive of ordinary size; they are slightly larger than the working bees, are not furnished with a sting, and have a shorter proboscis; the reason of their being so numerous would appear to be simply to allow the queen-bee to select her own mate, out of her numerous suitors, for after she has made her selection, they are simultaneously butchered by the working bees, and cast forth from the hive as useless encumbrances. The queen-bee alone, amidst this numerous assemblage, is capable of laying eggs, a circumstance easily accounted for when we reflect upon her extraordinary fertility. The working bees, according to Huber, are divided into two classes, the *wax-workers*, to whom is intrusted the charge of procuring food and furnishing the materials for building the comb, and the nurses, which are of smaller size, occupy themselves entirely with domestic duties, and to whom is intrusted the nursing of the young brood. As the honey-bee is not instructed by its instinct to construct a nest protected by any general covering, as is the case with the wasps and termites, it is obliged to select some cavity in which to build: this is sometimes a hollow tree, but more generally the hive, artificially prepared for its reception. In this retreat the workers construct their combs, made up of an immense assemblage of hexagonal cells, in which they educate their young brood, and store away provisions for the use of the community. The combs are always suspended perpendicularly and parallel to each other, leaving sufficient space between them to afford passage to the insects. The cells are thus placed horizontally. Skilful geometricians have demonstrated that the shape of the individual cells is precisely that which is most economical as relates to the expenditure of wax used in their construction, as well as that calculated to insure the greatest possible space. The bees, however, are able to modify their form according to circumstances. With the exception of such as are destined for the reception of the royal brood, these cells are all nearly of the same size; some are used as cradles wherein the young are

FIG. 110.—PROBOSCIS OF HONEY BEE.

lodged, while others are filled with honey, and the pollen of flowers. Some of the honey-cells are left open, others, used as a reserve, are carefully closed with a lid of wax. The royal cells, varying from two to forty in each hive, are much larger than the rest, and are suspended, like stalactites, from the margins of the combs.

The cells provided for the males are intermediate in their dimensions between these and those constructed for the reception of the young labourers. As the bees invariably build them from above downwards, those at the bottom are always the last constructed.

The queen-bee begins to lay her eggs in early summer, and continues to do so at intervals till the close of autumn. Reaumur has estimated that she will sometimes lay twelve

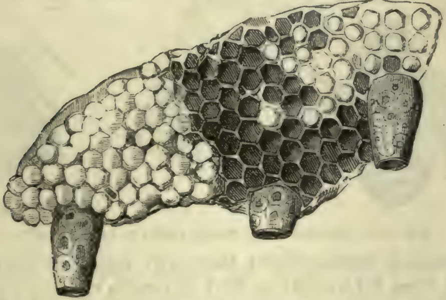


FIG. 111.—HONEYCOMB, WITH MALE WORKER AND ROYAL CELLS.

thousand eggs in the course of twenty days. Guided by an unerring instinct, she never makes a mistake in choosing the cells proper to receive her different kinds of eggs. Those laid in early spring always give birth to working

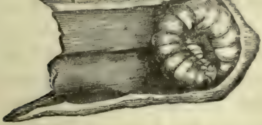


FIG. 112.—GRUB IN CELL.

FIG. 113.—PUPA.

bees; they are hatched in the course of four or five days, and the young larvæ are at once taken care of by the

nursing bees, and provided with food adapted to their condition. Six or seven days after their birth they dispose themselves to undergo their metamorphosis. Shut up in their cells by their nurses, who close the opening with a lid of wax, they line the walls of their narrow dwelling with a tapestry of silk, in which they spin a cocoon, become nymphs, and after about twelve days of seclusion, issue forth as working bees all ready taught, by their Divine instructor, how, at once, to set about their various avocations. The eggs from which the males are produced, are not laid till two months later, and shortly afterwards those which give birth to females are deposited.

The **Humble Bees** (*Bombus*) are well known to every schoolboy. Many of them dwell under ground, or in

FIG. 114.—HUMBLE BEES; MALE, FEMALE, AND WORKER.

moss-covered nests, where they live together in colonies varying from 60 to 200 or 300 in number.

Hugh Miller thus shortly describes the principal species of humble bees: "When a boy at Cromarty," says that elegant writer, "the wild honey-bees in their several species had peculiar charms for us. There were the buff-coloured *carders*, that erected over their honey-jars domes of moss; the lapidary, red-tipped bees, that built amidst the recesses of ancient cairns, and in old dry stone walls, and were so invincibly brave in defending their homesteads, that they never gave up the quarrel till they died; and above all, the yellow-zoned humble-bees, that lodged deep in the ground, along the dry sides of the grassy bank, and were usually wealthier in honey than their congeners, and existed in large communities. But the herd-boy of the parish, and the foxes of its woods and brakes, shared in my interest in the wild honey-bees, and, in the pursuit of something else than knowledge, were ruthless robbers of their nests."

Order Strepsiptera,* or Bee Parasites.

The Rev. Mr. Kirby had more than once observed upon several species of bees, something that he took to be a kind of *mite*, with which insects are very commonly infested, and determined not to lose the opportunity of taking one off for examination. On attempting, however, to disengage it with a pin, much to his astonishment, he drew forth from the body of the bee, what he imagined to be a white fleshy larva, a

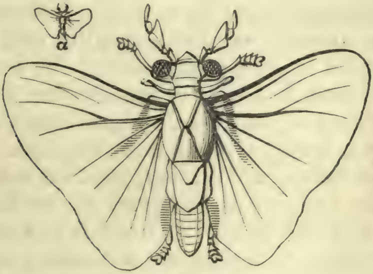


Fig. 115.—stylops.

quarter of an inch long, the head of which he had mistaken for a *mite*, it had neither mouth nor proboscis, nor any apparent means of obtaining food.

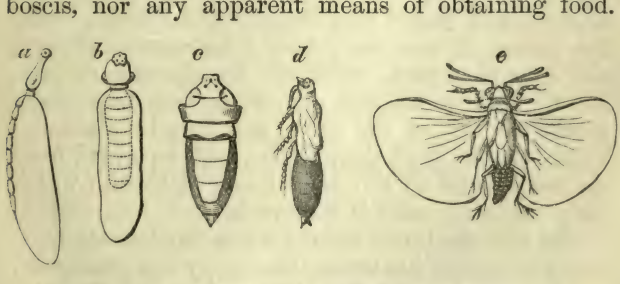


Fig. 116.—*a*, *b*, female.—*d*, pupa.—*e*, male of stylops.

"After I had examined one specimen," says Mr. Kirby, "I attempted to extract a second, and the

* στρέψις, strepsis, *twisting*; πτέρον, pteron, *wing*.

reader may imagine how greatly my astonishment was increased when, after I had drawn it out but a little way I saw its skin burst, and a head as black as ink, with large staring eyes, and antennæ, consisting of two branches, break forth and move itself briskly from side to side. It looked like a little imp of darkness just emerging from the infernal regions."

The above description will serve to give the reader a pretty good idea of the mode in which these insects are to be found, for they are all parasitic upon different species of bees and wasps; but the venerable and distinguished discoverer of these strange insects was in error in describing the soft grub-like creature which he first pulled out of the body of the bee as the *larva*, it being in reality the *female*, and the little "imp of darkness," whose emergence is so graphically described, is the male Stylops.

The true larva, a soft, maggot-like creature, resides in the interior of the grub of the bee, and in the interior of the bee itself, until it has attained its full size, when it undergoes a certain amount of change; the anterior portion of its body acquires a horny consistency, and is pushed out between the segments of the bee's abdomen, forming those little flattened bodies that first arrested Mr. Kirby's attention, and which may frequently be found upon the surface of our early bees (*Andrænæ*). This is the only change to which the females are subject, but the males become converted into true pupæ within the skin of the larva, and thus lie sheltered within the body of their victim, and separated from the outer world by the small horny plate with which their old integument is surmounted.

But the time soon arrives when the delicate little insect is to seek his mate; the horny cap gives way, and he emerges into light and air. A curious little fellow he is, but not without considerable pretensions to elegance in his appearance. The female, to whom this elegant and volatile little creature is incessant

in his devotions, is as different in appearance from her mate as can well be imagined. As already stated, she resembles a soft fleshy maggot, without the least trace of wings or limbs, and furnished anteriorly with a sort of horny head, much flatter than the rest of the body, which can be protruded with facility between the segments of the bee's abdomen. In their earliest form, just after quitting the egg, the larvæ are minute active creatures, furnished with six legs, by means of which the little creatures are enabled to run about freely upon the abdomen of the bee, in which their mother is parasitic; and so numerous are they in general that, according to Mr. Smith, this portion of the infested animal often appears as if it were dusted over with a whitish powder, from the crowds of these minute larvæ upon its surface. Thus carried about from flower to flower, amongst the hairs of the bee, some of them are left behind on every blossom she visits, where their activity renders it an easy matter for them to attach themselves to the body of the next comer. By this they are unconsciously conveyed to its nest, where they bury themselves in the bee larvæ, and remain feeding upon the substance of their unfortunate hosts, until they have attained their full development. Nevertheless, the *Stylopized* Bees, as they are called, fly about with the same activity as those which are free from such unwelcome guests, and thus tend still further to diffuse the race of parasites by which they are infested.

ORDER LEPIDOPTERA.*

Insects belonging to the Lepidopterous Order are at once recognizable from the structure of their four ample wings, which are generally thickly clothed on both surfaces with minute feather-like scales that overlap each other, and being of different colours arranged in patterns, often form a kind of mosaic

* λεπίς, lepis, *a scale;* πτέρον, pteron, *a wing.*

work of exquisite delicacy and beauty. Their mouth is adapted to pump up the nectareous juices from the cups of flowers, and is necessarily of considerable length, in order to enable the insect to reach the recesses in which the honied stores are lodged. When unfolded, the extraordinary apparatus resembles a long double whip-lash, and if examined under a microscope, is found to be made up of innumerable rings connected together and moved by a double layer of spiral muscles, that wind in opposite directions. When not in use, this singular pro-

FIG. 117.—SCALES OF BUTTERFLY'S WING.

boscis is coiled up into a very small space, and lodged beneath the head. The *larvæ* are commonly known by the name of caterpillars: they have a soft cylindrical body, three pairs of horny legs, and from four to ten pairs of false feet or "clingers" attached to the hinder segments, each composed of a circle of horny hooklets supported on a fleshy protuberance. The *pupa,* called a chrysalis, is motionless, and its limbs are folded down and covered with a transparent varnish. Their position, however, can be generally distinctly traced.

The Lepidoptera are classed by entomologists under three great sections. The **Diurnal,** that only fly by day; the **Crepuscular,** only seen during the morning or evening twilight; and the **Nocturnal,** whose period of activity is during the night: each of these will require separate notice.

The Diurnal Lepidoptera are

The **Butterflies** (*Papilionidæ*). These beautiful in-

sects, true children of the sun, are arrayed in the most gorgeous hues: their four ample and broadly-expanded wings being painted with very variety of brilliant tints, arranged in most diverse patterns, sometimes resplendent with metallic glosses, often flushed with rainbow hues, that play over the surface with the changing light, and often presenting that peculiar charm that results from the association of colours that are complemental to each other. These various hues, so characteristic of the Order, depend on the presence of the minute feather-like scales with which the wings are thickly clothed. To the

FIG. 118.—COMMA BUTTERFLY.

naked eye they appear merely as a fine dust, easily rubbed off by the finger; but under the microscope they are seen to be thin transparent films, each attached by a short

FIG. 119.—WHITE HAWTHORN BUTTERFLY.

stalk to the surface of the wing, set side by side in close array, and overlapping each other like the scales of a fish. The true butterflies are distinguished by the shape of their antennæ, which are long and thread-like, and generally terminated by a club-shaped dilatation; sometimes, however, they are of equal thickness throughout, or even thinnest at the end, where they terminate in a hooked point. Most of them when reposing have their wings

raised perpendicularly, so that their backs touch each other, and nothing is seen of them but their under surface. Butterflies generally pass their pupa state without any external protection, their chrysalis being in most cases either suspended loosely by the tail, hanging in a perpendicular position from a little button of silk (Fig. 120), or having in addition to this support a girdle of silk passing round the body and fastened on each side, by which the chrysalis is supported horizontally or obliquely. These chrysalids are generally ornamented with gold-coloured spots, from which they receive their name; moreover, they frequently present externally spines and angular points, giving them a very remarkable appearance.

FIG. 120.—PUPA OF VANESSA.

In the second section of Lepidopterous insects, **Crepuscularia**, are placed

The **Hawk-moths** (*Sphinx*). These are furnished with a

FIG. 121.—UNICORN HAWK-MOTH.

stiff scaly spine, upon the outer border of their lower

wings, which is received into a kind of hook, situated beneath the upper pair, and keeps them, when in repose, in an inclined or horizontal position; their antennæ are for the most part prismatic or angular in their shape, or sometimes they are toothed like a comb. Their caterpillars have always sixteen feet, and their chrysalids are destitute of the angular projections which frequently exist in those of the Diurnal species. They are, moreover, generally enclosed in a cocoon, and sometimes buried in the earth. These insects are only seen on the wing in the grey dawn of morning or in the evening twilight. The type of the family is the genus *Sphinx*, so called because the usual attitude assumed by their caterpillars resembles that attributed to the Sphinx of ancient fable. These insects in their perfect state fly with great rapidity, hence is derived their name of Hawk-moth; they may frequently be seen poising themselves on the wing before the bells of tubular flowers, from which they extract the nectar by means of their long and flexible proboscis. The largest of our native species is

The **Death's-head Hawk-moth** (*Sphinx Atropos*), so called from a singular mark resembling a skull and cross bones, which it bears at the back of its thorax. Probably on account of its carrying these lugubrious in-

FIG. 122.—DEATH'S-HEAD HAWK-MOTH.

signia, this fine insect is generally looked on by the ignorant with superstitious dread, and its occasional twilight intrusion into a house is an event commonly regarded with horror. Yet it is a harmless creature, except that it

will sometimes make its way into a beehive, and regale itself with honey: the bees, in some way not understood, tolerating its visits, although they might easily sting it to death. The caterpillar is very large, attaining a length of five or six inches, its colour is yellow, ornamented with blue stripes on the sides; it feeds on the leaves of the potato, the vine, and the jasmine, and in the month of August, burrows into the earth to undergo its pupa change. The perfect insect makes its appearance in the month of September.

The **Nocturnal Lepidoptera** always keep their wings when at rest in a horizontal or inclined position; in this respect they resemble the Crepuscular species, from which, however, they are easily distinguished by the shape of their antennæ, which diminish in size from the base to the point, or, in other words, are setaceous. These Lepidoptera, which are sometimes called Phalenæ, ordinarily fly only at night, or in the evening after sunset. In some species, the females are without wings, or have them very small. Their chrysalids are almost always round or lodged in a cocoon.

This family is very numerous, and is divided into several tribes; the most interesting is that of the **Bombyces** (*Bombyx*),* to which belongs—

The **Silkworm** (*Bombyx Mori*).

Its caterpillar has a smooth body, and at its birth is scarcely a line in length, but attains to even more than three inches. In this form the silkworm lives about thirty-four days, and during that period changes its skin four times. It feeds on the leaves of the mulberry; at the time of moulting it does not eat, but after changing its skin, its appetite is doubled. When it is ready to change into a chrysalis, it becomes flaccid and soft, and seeks a proper place where to construct a cocoon, in which it encloses itself: the first day is occupied in attaching, in an irregular manner, threads of silk to neighbouring objects to support it. The second day it begins to multiply these threads, so as to envelope itself, and on the third day it is completely enclosed in its cocoon.

* *βόμβυξ*, bombyx, *a silk-worm.*

This nest is formed of a single filament of silk wrapped around the animal, and its turns are glued together by

Fig. 123.—Silkworm on mulberry-leaf.

a kind of gum. It is estimated that the length of the filament in an ordinary cocoon is nine hundred feet. The form of the cocoon is oval, and its colour either yellow or white.

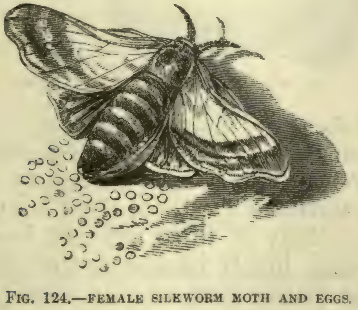


Fig. 124.—Female silkworm moth and eggs.

The bombyx remains in the chrysalis state in the interior of its cocoon about twenty days, and when it has finished its metamorphosis, disgorges upon its walls a peculiar liquid, which softens it, and enables the animal

to make a round hole through which to escape. To obtain the silk produced by these animals it is, therefore, necessary to kill them before they pierce the cocoon, and then wind or reel off the thread or filament of which it is composed. To unglue it, the cocoons are soaked in warm water, then the filaments of three or four are united into one thread. That part of the cocoon which cannot be reeled off in this way is carded, and constitutes floss silk.

The mulberry bombyx is not the only moth that yields silk that can be usefully employed. The inhabitants of Madagascar make use of a species, the caterpillars of which live in numerous bands, and form a common nest, sometimes three feet high,

FIG. 125.—COCOCN OF TUSSEH SILKWORM.

containing about five hundred cocoons. The thread of the tusseh silk-worm is likewise valuable.

The smaller moths are extremely numerous; nearly two thousand species of them are enumerated as British. Many of these are very beautiful, and many more are highly interesting from the habits of their larvæ; among them we may select

The **Leaf-rollers** (*Tortrices*),* so named from their habit of rolling up the edges of leaves in various forms, and so fastening them with silk, as to make compact

* Tortrix, pl. Tortrices, fem. of Tortor, *one who twists.*

tubular cases in which the larvæ live (Fig. 126). Others having made a little tent, set it upright on the leaf from

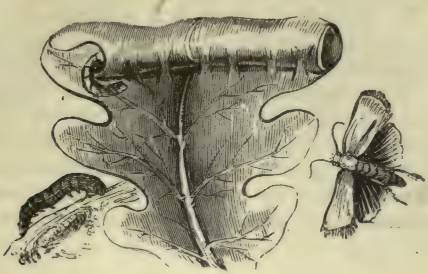


FIG. 126.—LEAF-ROLLING CATERPILLAR.

which it has been cut. These are everywhere to be found upon our trees and hedges. Others, again, make a domicile by uniting the opposite edges of a leaf, or fastening

FIG. 127.—SUSPENDED LEAF TENTS.

two leaves together by means of silk, and suspend the hammock so formed at the end of a silken thread from a twig, and thus the little caterpillar lodges securely, rocked by the winds.

The **Moths** (*Tineæ*),* whose caterpillars frequently feed

* Tinëa, Lat. A moth or worm in clothes or books, "dirum Tineæ genus." Virgil Georg. iv., 246.

on cloths and peltry, are also nocturnal Lepidoptera. The clothes-moth, fur-moth, grease-moth, green-moth, and various other destructive moths, are mostly very small insects, the largest of them not measuring, with their wings expanded, more than eight-tenths of an inch.

The **Pack-moth**, or *Tinea Sarcitella*, is but too well known. Its caterpillar lives on cloth and other woollen stuffs, weaving with their detached particles, mixed with silk, a portable tube, which it lengthens at each end in proportion as it grows, and slits when too small, to increase the diameter by inserting another piece. From this circumstance it obtains the specific name of *sarcitella.**

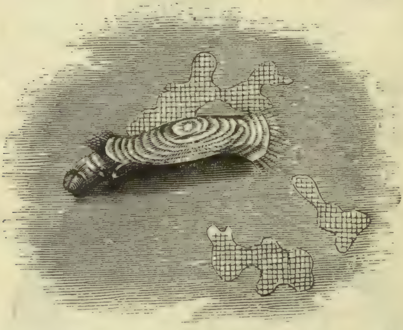


FIG. 128.—LARVA OF CLOTHES-MOTH IN ITS CASE. (*Magnified.*)

The **Feather Moths** (*Fissipennæ*)† likewise belong to the nocturnal lepidoptera. This tribe is distinguished by the singular structure of the wings, which, in a state of repose, are straight and elongated. The four wings, or two of them at least, are slit through their whole length into branches, which are barbed on the sides, bearing some resemblance to an outspread feather fan.

ORDER HEMIPTERA.‡

In insects belonging to this Order, the elytra, or wing covers, present two distinct portions of very

* Sarcio, *I patch.*
† Lat. Fissus, *cleft;* penna, *a wing.*
‡ ἥμισυς, hemisus, *half;* πτέρον, pteron, *a wing.*

different texture, their front part being stiff and leathery, while their hinder margins are membranous and thin. It may likewise be noted that the membranous portion of one wing when in a state of repose overlaps that of its fellow. Their mouth is adapted for piercing the skin, and imbibing the juices of the animals upon which they live. Instead of cutting jaws, such as we have met with in the mandibulate orders of insects, we now find the parts of the mouth to consist of a long beak, or *rostrum*, along the upper surface of which runs a groove, wherein are lodged four long, sharp-pointed filaments, that constitute a kind of sting. The Hemiptera retain in all the three stages of their growth the same form and the same habits; the only change that they undergo consists in the development of their wings, the rudiments of which first make their appearance when they enter into the pupa state. These insects are usually known by the general name of **Bugs**, a term which in itself is sufficient to cast obloquy upon the whole race; many of them, however, are large and richly coloured, and we have seen one preserved in fluid, and set in a brooch, which rivalled many a gem in beauty and in brilliancy. They usually lurk about plants, and prey upon hapless insects, into whose bodies they plunge their piercing sucker, and thus obtain their food.

FIG. 129.—FIELD-BUG.

The *Hemiptera* are divided by naturalists into two great sections, named respectively **Geocorysæ** * and **Hydrocorysæ**,† two very hard words, which, however, when translated into plain English, mean **Land-bugs** and **Water-bugs**; of the former of these sections we have already spoken, but the latter will require a few words of notice.

Perhaps no locality could be pointed out more

* γῆ, ge, *the earth;* κόρις, coris, *a bug.*

† ὕδωρ, udor, *water;* κόρις, coris, *a bug.*

abounding in food than the surface of stagnant water. Countless insects are continually falling into every pond, where their drowned carcases may be seen floating. It is to utilize this abundant store of provisions that the Hydrocorysæ have been specially constructed. Such, for example, are

The **Water-measurers** or **Skip-jacks** (*Hydrometra*),* anywhere to be seen in summer time, in every ditch, running upon the surface of the water with as much activity as though it was frozen into ice, and not even wetting their feet. These, from *above* are reaping a rich harvest of dead flies which they pierce with their beaks, and suck their juices; while, from *below*,

The **Water-boatmen** (*Notonecta*),† are eagerly engaged in sharing such a rich supply of nutriment. These Noto-

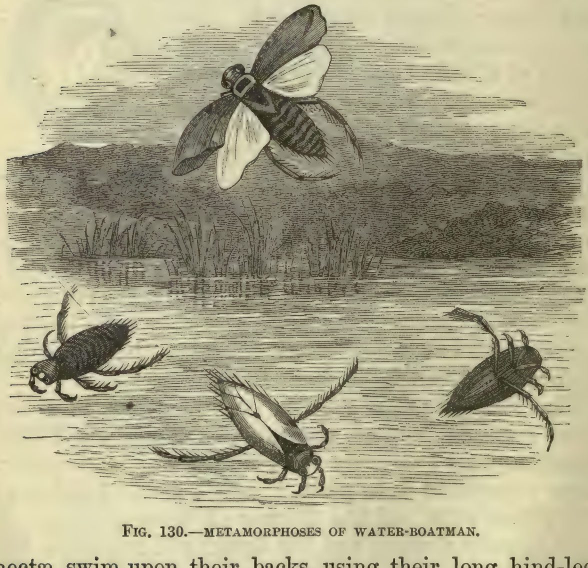


FIG. 130.—METAMORPHOSES OF WATER-BOATMAN.

nectæ swim upon their backs, using their long hind-legs as oars, and thus they dart on any drowning fly that happens to attract their notice.

* ὕδωρ, udor, *water*; μετρέω, metreo, *I measure.*

† νῶτος, notos, *the back*; νηκτὴς, nectes, *a swimmer.*

The **Water-scorpion** (*Nepa*), an inhabitant of every pool, procures its food upon the stems of submerged plants, or creeps in search of it about the bottom of the pond. This insect is able to inflict a very painful wound if seized incautiously, by means of its strong well-armed beak.

FIG. 129.—WATER-SCORPION.—DIFFERENT STATES OF NEPA.

ORDER HOMOPTERA.*

As the Hemiptera were obviously designed to obtain their food by imbibing the juices of dead or of living animals, it can be no matter of surprise to find races of insects much more numerous and important, appointed to feed upon the sap of plants, and that by means of a mouth of very similar construction.

The **Homopterous Insects**, or *Plant-suckers*, as they have been named, are furnished with four large wings, all of which are transparent, and but loosely veined. By means of these they fly from plant to

* ὁμός, homos, *similar;* πτέρον, pteron, *a wing.*

plant, the juices of which seem to be specially appropriated to their use. Such are

The **Tree-hoppers** (*Cicadæ*), some of them celebrated for their noisy music. The Cicadæ pass their lives upon trees or shrubs, upon the sap of which they live.

The **Plant-lice** (*Aphides*) are small homopterous insects. They abound in every garden, living on trees and plants in countless multitudes; indeed, the fecundity of these creatures seems absolutely boundless. It has been calculated that if a male Aphis were to live to see his progeny of the fifth generation gathered around him, he would find himself the great-great-grandfather of nine

FIG. 130.—LIME-TREE APHIS.
(*The lines under the figure show the actual size.*)

billions nine hundred and four millions of Aphides; or, in other words, of a family about fifty times more numerous than all the human inhabitants of this globe. With such a fact before us, we leave our readers to judge what might be the result of their undisturbed multiplication. In the course of a few months, even these apparently despicable plant-lice would become a plague, as terrible as any with which the world has been visited. Fortunately, even here, the balance between increase and destruction is held with an unwavering hand, so that when we notice the innumerable enemies by which their legions are unremittingly attacked, we are almost led to

wonder how any of them escape from such hosts of hungry and relentless foes.

Let us not imagine, however, that these insects have been created in such numbers merely for the purpose of destroying vegetation, and of affording food to voracious persecutors. Man, as we shall soon perceive, has by no means been forgotten in their distribution.

The **Coccidæ**, so called from the valuable Grecian dye, *κοκκος*, more than counterbalance, by the richness of their productions, all the devastation caused by the Aphides we have been describing, and various European and Asiatic species are sources of considerable wealth to the countries where they are found; but the discovery of

The **Cochineal Insect** (*Coccus Cacti*), which lives in immense numbers on the *Cactus Cochinelifer*, from the brilliancy of the colour it affords (cochineal), has thrown the dyes derived from other species into the shade, and has proved one of the most productive sources of wealth to the countries where it is cultivated. Another important species, the *Coccus lacca*, furnishes the valuable Indian product called *lac*, an article of so much importance in the manufacture of varnishes, sealing-wax, &c. Another species of Coccus is found upon the Tamarix mannifera, a large tree which grows in Syria. The female insects, puncturing the young shoots, cause them to discharge a vast quantity of a peculiar secretion (manna), which quickly hardens, and drops from the tree, where it is collected by the natives. Other species produce in abundance a substance almost

Upper surface. *Under surface.*

FIG. 131.—COCHINEAL INSECT. (*Magnified.*)

identical with wax. The Chinese collect it at the approach of autumn, by scraping the boughs on which it is found. It is then melted and strained into cold water, when it hardens, and is made into cakes exactly resembling white wax, and is used for similar purposes. Various other important results of their industry might

be enumerated; but we have said enough to show that these despised vegetable parasites are by no means unprofitable members of the animal creation.

Equally well known, and unfortunately almost as abundant as the Aphides, are

The **Blight Insects** (*Psylla*), the pests of our orchards and the destructive causes of what is called "the blight" upon our fruit trees. It would seem, indeed, that every tree and shrub supports a special race of these creatures, which are distinguished by entomologists by the names of the plants upon which they are found. In the preparatory stages of their growth, these insects are generally covered with a white cottony substance, matted together with a sweet and gummy secretion.

The **Lantern Flies** (*Fulgora*) are distinguished by the extraordinary conformation of their heads, which are expanded into an enormous muzzle, nearly equalling in size all the rest of the body. They have long had the reputation of emitting a brilliant phosphorescent light; but whether they possess such a faculty or not is extremely doubtful.

Order Diptera.*

The insects belonging to this Order possess but a single pair of wings, which are always transparent, veined, and without folds. The place of the hind wings is occupied by a pair of slender filaments called poisers; their mouth is adapted for suction, and in many species is supplied with piercing instruments of very formidable character.

To this Order belong

The **Gnats** (*Culex*), known in foreign countries as *Mosquitoes*, and universally dreaded, on account of the sharpness of their envenomed bite. They are the most insolent, the most insatiable, of blood-suckers. Their terrible proboscis is a chef-d'œuvre of mechanism. From a long grooved and flexile sheath there issue forth long slender darts, so sharp and subtle that they slip with ease through our poor skins; vainly we try, warned by the

* δίς, dis, *twice, double*; πτέρον, pteron, *a wing*.

shrill small trumpet of the little pest, to ward off such a despicable foe; too soon our legs and hands and face, pierced to the blood, covered with lumps and painful swellings, proclaim the efficiency of the dreadful weapon. Neither heat nor cold seems to affect these tormentors of the human race. In Lapland they swarm to such an extent during certain periods of the year, that there is neither rest nor sleep for the inhabitants indoors or out, unless in the suffocation of thick smoke, or under the defence of a thick unguent composed of grease, tar, and oil.

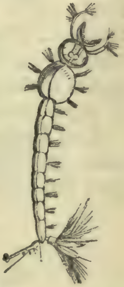


FIG. 132.—LARVA OF GNAT.

The transformations of the common gnat (*culex pipiens*), are well worthy of our attention, and may be observed in any water butt. The female gnat, descending from her aërial dance among the slanting beams of sunset, alights cautiously on the surface of the water, where the lightness of her body, and the expanse covered by her slender feet, prevent her not only from sinking, but even from becoming wetted. She then crosses her hind legs, thus making a sort of frame in which her eggs are deposited, in the shape of a little boat, so buoyant and so repellant to the water that it is impossible to sink it. In the course of a couple of days the eggs, thus left to float, are hatched, and the larvæ escape; they may then be seen wriggling about with considerable agility, now descending, now ascending


FIG. 133.—ESCAPE OF GNAT FROM ITS PUPA-CASE.

slowly to the surface, where they hang suspended from a little tube affixed to their tail, through which they breathe

the air. In about a fortnight they change into pupæ, equally active, but very different in their shape, for instead of the respiratory tube near the tail possessed by the larva, the pupa breathes by means of two trumpet-shaped pipes affixed to the back of the thorax. The time at length arrives when the aquatic pupa has to give birth to an insect, whose filmy wings would be spoiled by the slightest wetting. The process by which this is accomplished affords a very interesting spectacle. The pupa having risen to the surface, elevates its thorax above the water, the skin soon splits down the back and exposes the foreparts of the gnat, which are quickly protruded, and the gnat floating on its old skin as in a boat, extricates its wings from their cases and its legs from their boots. The wings unfold themselves, and the little creature flies away to enjoy its new existence in another element.

The **Crane Flies** (*Tipula*) constitute a very numerous race, some of which are nearly related to the gnats, and pass the first period of their existence in the water. In

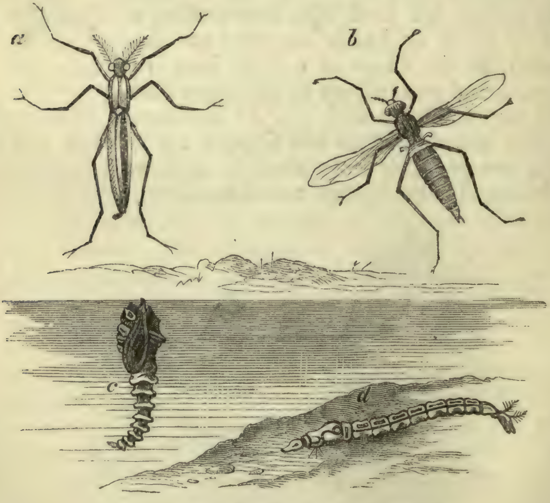


FIG. 134.—METAMORPHOSES OF BLOOD WORMS.

their larva state they resemble little red worms, having their tails furnished with long curling filaments, some-

what resembling the arms of a hydra, hence they have been called "polype worms;" these are often found in ponds in great numbers. Their nymphs, which inhabit the same element, resemble those of the gnats above described, and the escape of the perfect insect is managed precisely in the same manner. Other Tipulæ, as, for example,

The **Daddy-long-legs** (*Tipula oleracea*), so commonly met with amongst the grass in our meadows, are derived from larvæ that live in the ground, or are found in old

FIG. 135.—PUPA AND INSECT OF CHIRONOMUS.

bark or rotten trees. Their nymphs are naked, breathe by means of two respiratory tubes situated near the head, and have the rings of their abdomen covered with little spines.

The **Whame Flies** (*Tabanus*) constitute a very formidable race, having appended to their proboscis six lancets so strong as to penetrate the skin of the horse. These insects, which generally make their appearance towards the close of spring, are common in woods and pastures. They fly with a buzzing sound, and pursue even man himself in order to suck his blood. The unfortunate cattle, having no means of resisting their attacks, are sometimes covered with blood owing to the bites of these insects; and Bruce, the Abyssinian traveller, speaks of one species, before which even the lion quails. Their larvæ are long cylindrical maggots, tapering towards the head, which is provided with a pair of hooks instead of jaws. Their pupa is naked, nearly cylindrical, with hairs

around the edges of its segments, and provided with six spines at its hinder extremity: it comes to the surface of the ground when about to be transformed into the perfect fly, showing its body half out of the earth.

The **Tsetse,** described by Dr. Livingstone, is perhaps the most formidable of the insect race; it is not much larger than the common house-fly, and is nearly of the same brown colour as the honey-bee. The bite of this poisonous insect is certain death to the ox, horse, and dog; but is perfectly harmless to man, wild animals, and even calves as long as they continue to suck. Its poison is inserted by the middle prong of three portions, into which the proboscis divides, which it plunges deeply into the skin exactly in the same manner as a gnat, and then sucks the blood until it is filled. A slight itching irritation follows, but not more than that produced by the bite of a mosquito. In the ox this same bite produces no more *immediate* effects than in man; but in a few days, the poor creature bitten, sickens and dies. This terrible insect is, fortunately, confined to certain parts of Africa.

The **Chameleon Flies** (*Stratyomys*), so called from the variety of their colours, are a very harmless race, remark-

FIG. 136.—LARVA OF STRATYOMYS.

able on account of the phenomena attending their metamorphosis. Their larvæ are to be found in ditches abounding with filth; their bodies are long, flattened, and tapering towards each extremity, their skin is of a horny or leathery texture, and their tail is surrounded by long, plume-like hairs, that encircle the orifice through which they breathe.

The skin of the larva is not cast off, but becomes the cocoon of the pupa, simply growing stiff and angular. In this condition they may be found floating on the surface. When the perfect insect is complete, it escapes through a fissure in the second segment, and after floating about for a little time, supported by its old integument so as to allow its wings to dry, it takes flight.

The **Wasp Flies** (*Eristalis*), everywhere to be seen on a hot day, hovering before the flowers in our gardens, and darting here and there with sudden jerking movements, commence their lives under a very different aspect. Their larvæ are provided with a breathing apparatus, which

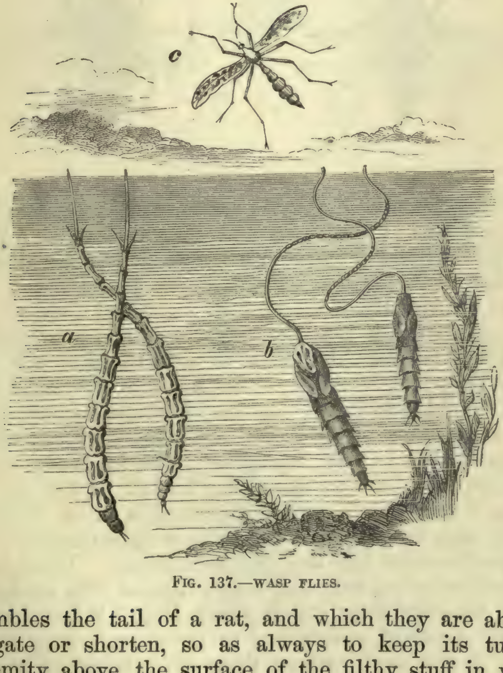


FIG. 137.—WASP FLIES.

resembles the tail of a rat, and which they are able to elongate or shorten, so as always to keep its tubular extremity above the surface of the filthy stuff in which these creatures live. They are often found in great numbers in old tubs that contain stinking rain-water.

The **Gad Flies** (*Oestrus*) have much the appearance of humble-bees, and the hairs that densely clothe their bodies

are in like manner bounded with yellow-coloured zones. They are fortunately not very common, the time of their appearance, and the districts they inhabit, being limited. There are several species of these dreaded flies, each of which passes its larva condition as a parasite, living at the expense of some particular quadruped. The horse, the ox, the ass, the reindeer, the stag, the antelope, the camel, the sheep, and the hare are, however, the only animals certainly known to be subject to their attacks, and these all seem to be inspired with a special dread of their

FIG. 138.—GAD FLIES.

insect tormentors. Of these larvæ, some are deposited under the skin of the backs of cows by means of a peculiarly-constructed ovipositor, with which the females are provided. The eggs of others are simply glued to the skin in the vicinity of the nose of sheep and deer, whence the maggots creep into the nostrils of the poor animal, where they reside. The larvæ of a third kind are only met with in the stomach of the horse, where alone they find a suitable residence. In this situation they are called *bots;* the manner in which they are introduced into such a strange locality is very ingenious. The fly, when laying her eggs, may be seen balancing herself in the air and glueing them to such parts as the horse is in the habit of licking with his tongue, and thus he is made unconsciously to introduce them into their proper nursery. These larvæ are footless, of an oval shape, and banded with circles of hooks, whereby they attach themselves. When mature, they are expelled, and falling to the ground, bury themselves in the earth, where their last change is accomplished.

The Flesh Flies (*Musca*) are too well known to need description. These creatures deposit their progeny in tainted or in putrefying flesh, and notwithstanding the

petty injury they inflict in our larders, must be looked upon as being among the most important agents employed in the police of Nature. Death is everywhere abroad, but the earth is not permitted to be long defaced by the presence of decay. No sooner does the carcase fall, than these,

"The swiftest of HIS winged messengers,"

are set to work, and speedily remove the offensive carrion. Linnæus asserted that three flesh flies could devour a dead horse in less time than it would take a lion to effect

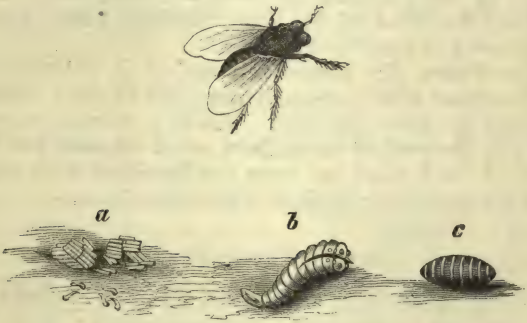


FIG. 139.—METAMORPHOSES OF FLESH FLY.

the same object; and a little consideration will show that the expression is not exaggerated. The hungry lion can but make a meal, and then must wait for his returning

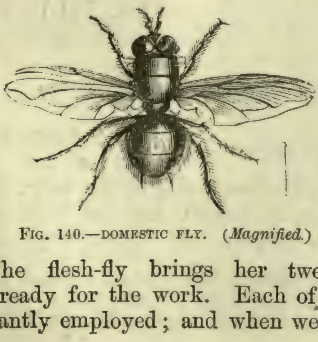


FIG. 140.—DOMESTIC FLY. (*Magnified.*)

appetite. The flesh-fly brings her twenty thousand young ones, ready for the work. Each of these for five days is constantly employed; and when we consider that

these voracious maggots, in that space of time increase in weight two hundred fold, and that they are further capable of giving birth in a short time to other insect legions, we perceive at once their adaptation to the important duty thus intrusted to them.

The **Spider Flies** (*Hippobosca*) * are parasitic, and, strange to say, their females give birth to *pupæ* instead of eggs or *larvæ*, hence they have been designated *Pupipara*.† These pupæ are of considerable size, and at first very soft, but their skin soon hardens into a pupa-case. These insects are remarkable from having no wings. Some of them inhabit the nests of birds, and live by sucking the blood of the little nestlings, whose warmth contributes to their development.

The **Forest Fly** (*Hippobosca equina*) is notorious for its incessant attacks upon horses; and in some districts appears in great numbers. Another species conceals itself in the wool of sheep, from which animals it derives its food; and there are some not furnished with wings, that are exclusively resident in the hair of bats.

Order Thysanoura.‡

These insects are without wings, and undergo no metamorphosis; they are distinguished by the possession of peculiar instruments of locomotion, appended to the extremity of their abdomen. (Fig. 141.) The order includes but two genera, the **Sugar-lice** and the **Spring-tails.**

Fig. 141.—Artic spring-tail.

The **Sugar-lice** (*Lepisma*) have a row of filaments attached to the hindmost ring of the body, three of which are of considerable length, and by their assistance the Lepisma leaps into the air. Their legs are short, but

* ἵππος, hippos, *a horse*; βόσκω, bosco, *to feed on.*
† Pupa, *a pupa*; pario, *I bring forth.*
‡ θύσανος, thysanos, *a tuft*; οὐρά, oura, *tail.*

they run with great swiftness. Many species of these insects lurk in the chinks of window-sashes that are seldom opened, or they hide under wet planks and in cellars.

The **Spring-tails** (*Podura*) have their tail terminated by two stiff spines, which are usually bent under the body. By suddenly extending this apparatus, which acts as a spring, the insect leaps into the air like a skip-jack, and falls upon its back. The Poduræ are found under the bark of trees, or sometimes on the surface of stagnant water, or even of snow. They are generally congregated together in considerable numbers, and have very much the appearance of grains of gunpowder.

Order Parasita.

The **Parasita** are wingless insects that do not undergo metamorphoses, and whose abdomen is without any terminal appendage (Fig. 142). Their mouth is adapted for suction, their body is flattened, and, as their name indicates, they live upon other animals. They, however, are only met with in mammals and birds. They are generally known by the name of

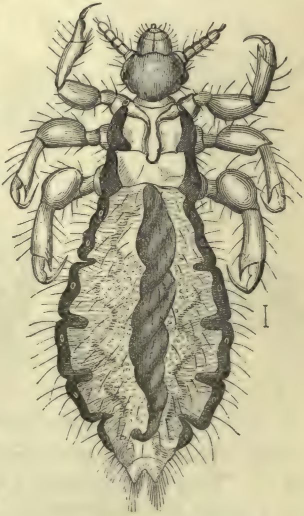


FIG. 142.—LOUSE.

Lice (*Pediculus*) and **Ticks** (*Ricinus*). The latter, with the exception of the Dog-tick, only infest birds. These insects by means of two opposite claws, with which their feet are armed, cling to the hairs of quadrupeds and the feathers of birds, in which situation they pass their lives, and sometimes multiply very rapidly. They fasten their eggs,

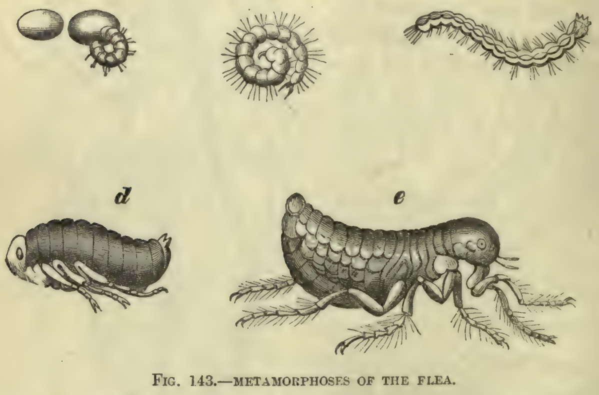
which are called *nits*, to the hairs or feathers upon which they climb.

Order Aphaniptera.*

These insects, like those belonging to the preceding order, are wingless, but they undergo a metamorphosis. Their body is very much compressed at the sides, and the legs adapted to leaping. The mouth is provided with lancets, and performs the functions of a sucking apparatus. In their larva state they resemble little worms, and are quite destitute of feet. The perfect insect lives upon quadrupeds and birds. This order comprehends—

The **Fleas** (*Pulex*). The common flea (*Pulex irritans*) lives upon dogs, cats, and men, whose blood it sucks. The female lays about a dozen eggs, white and slightly

a *b* *c*



d *e*

Fig. 143.—Metamorphoses of the Flea.

viscid. These eggs give birth to larvæ, which are very active. They roll themselves up into a spiral circular form, and wriggle about like minute serpents. In about twelve days these larvæ enclose themselves in a little cocoon, where they become *nymphs*, and in about twelve days more issue forth in their perfect state.

* ἀφανής, aphanes, *hidden*; πτέρον, pteron, *a wing*.

Another species called the **Chigoe** (*Pulex penetrans*), very common in the warm parts of America, is armed with a beak as long as its body. The abdomen of the female, when distended with eggs, grows to the size of a small pea, while the insect itself is scarcely so large as our common species. It insinuates itself beneath the skin and into the flesh of men and other animals, particularly about the feet and toes, where it deposits its eggs and sometimes causes great pain and ill-conditioned sores. The only remedy is to remove the eggs, which are enclosed in a little bag, with a needle, an operation which the negroes perform very skilfully.

The Thysanoura, Parasita, and Aphaniptera, having no wings, are frequently spoken of under the general name of **Aptera**, or apterous (*i. e.* wingless) insects. All the other orders of insects have wings, and are spoken of as "*winged insects.*"

CHAPTER XII.

ARACHNIDA.*

THE **Arachnidans**, long confounded with the **Insects**, and still commonly described as such, are distinguished from the true members of the insect world by characters so conspicuous, that the necessity for considering them as a distinct class must be obvious to any one.

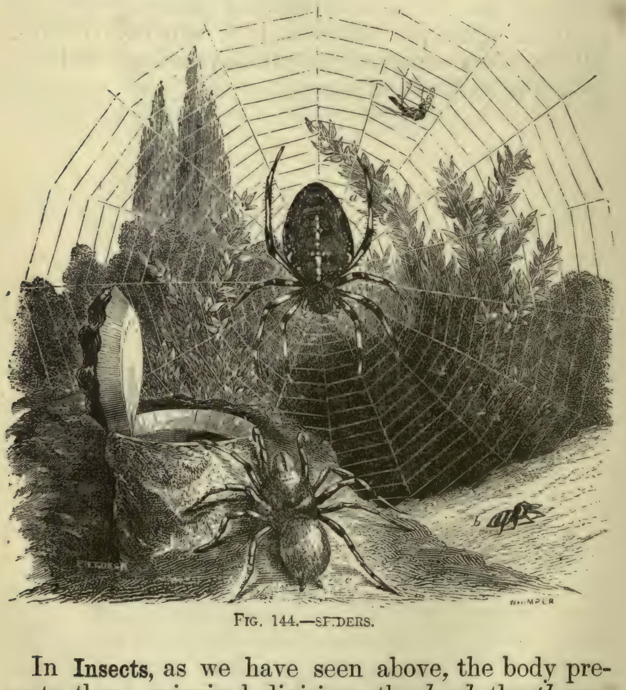


FIG. 144.—SPIDERS.

In **Insects**, as we have seen above, the body presents three principal divisions, the *head*, the *thorax*, and the *abdomen*; but in the spider tribes, the blood-

* ἀράχνη, arachne, *a spider*.

thirsty destroyers of the insect world, the separation of the head from the thorax, which, by increasing the flexibility of the external frame-work, diminishes the strength of the body, is no longer admissible. In the Arachnidans, therefore, the head and thorax are conjoined, leaving only two divisions of the skeleton, the *cephalo-thorax* * and the abdomen.

Insects were found, in their mature state, to have only *six* legs, but in the adult Arachnidans, *eight* ambulatory limbs are always present. The lower forms of the Arachnidans breathe in the same manner as insects, by means of air-tubes distributed throughout the interior of their bodies; but in spiders and scorpions, the most typical groups, the respiratory apparatus is constructed upon very peculiar principles, being neither composed of gills adapted to breathe water, nor of lungs like those of many other air-breathing animals, but presenting a combination of the characters of both. Their breathing organs resemble bags, the sides of which are so folded and plaited that a considerable surface is presented to the influence of oxygen. It is, indeed, highly probable that these organs are intermediate in function, as well as in structure, between an aquatic and an air-breathing apparatus, for as these creatures always frequent moist situations, the dampness of the atmosphere may be favourable to the due action of the air upon their circulating fluids. To these remarkable breathing organs the term *pulmo-branchia* has been applied, a name descriptive of their combined function of lungs and gills. Each **pulmo-branchia** opens externally upon the under surface of the body by a distinct orifice, resembling the spiracle of an insect, and closed in a similar manner by moveable horny lips. In the Scorpion (Fig. 55), the spiracles are eight in number, placed upon the ventral aspect of the body; and just in front of the first pair are two remarkable organs, represented in the figure, which resemble a pair of combs, and are apparently adapted

* κεφαλή, cephale, *the head;* and θώραξ, thorax, *breast-plate.*

to keep the spiracular orifices free from dirt, and thus prevent any obstruction to the free ingress and egress of the air.

The above characters would in themselves be sufficient to discriminate between the two classes; but when we add that, in the Arachnidans, the eyes are always simple, and the antennæ of insects represented by organs of a totally different description, we need not enlarge further upon the distinctions between them.

The Arachnidans may be grouped in three principal divisions, generally known by the names of **Mites, Scorpions,** and **Spiders.**

The **Mites** (*Acari*), breathe by means of air-tubes, resembling those of insects, which are so arranged as to convey air to every part of the system.

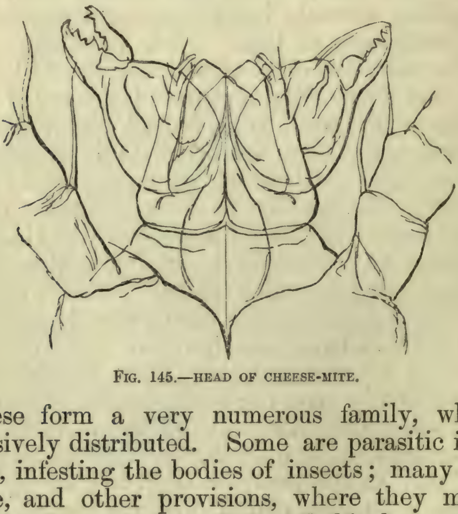


FIG. 145.—HEAD OF CHEESE-MITE.

These form a very numerous family, which is extensively distributed. Some are parasitic in their habits, infesting the bodies of insects; many live in cheese, and other provisions, where they multiply prodigiously, and not a few inhabit leaves, or are found under stones and beneath the bark of trees; while others, such as the pretty scarlet water-mite, common in every pond, are aquatic.

The **Scorpions,** forming the second division, are at

once recognizable by the peculiarity of their external configuration. Their palpi, the representatives of the maxillary palpi of insects, are enormously large, resembling in their shape and proportionate size the claws of a lobster, while the hinder part of their body, corresponding with the abdomen, is much prolonged, and composed of numerous joints, sometimes ending in a sharp hooked point, which constitutes their sting, and gives emission to their much-dreaded venom.

Scorpions usually lurk under stones, in ruined buildings and caves, or other dark and damp situations, sometimes even in the interior of houses. They run quickly, brandishing their tails over their backs, and with this they kill beetles, locusts, and other insects, which they catch by means of their formidable pincers. The female scorpion produces her young at different intervals; she carries them on her back during the first few days of their existence, and carefully watches over their safety for upwards of a month, when they become able to provide for their own subsistence.

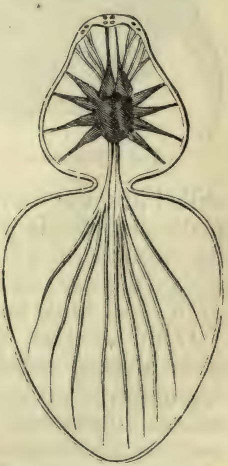


FIG. 146.—NERVES IN SPIDER.

The third division of the Arachnidans comprehends the well-known race of **Spiders**, equally remarkable for their voracity and their cunning. They are distinguished by having their abdomen short and globular, and by its being furnished near its posterior termination with a wonderful apparatus, by means of which these animals manufacture silken filaments applicable to a great variety of purposes and especially employed in constructing what is usually named the Spider's *web*

Spiders are the implacable foes of insects, with which they wage cruel and unremitting warfare. That the destroyer should be more powerful than its victim is essential to its position; that it should excel its prey in sagacity, is likewise necessary to its existence; and by following out the same principle which has been already insisted on concerning the inseparable connection which exists between the perfection of an animal and the centralization of its nervous system, we find in the class before us an additional confirmation of this law. The whole series of ganglia become here aggregated together, forming, as it were, one great central brain, from whence nerves radiate to all parts of the body.

The mouth of the spider is a tremendous piece of machinery. The mandibles, or jaws, are each terminated by a moveable fang, which ends in a sharp point, and is perforated near its extremity by a minute orifice, from which, when the spider bites, a venomous fluid of great potency is instilled into the wound inflicted. Such, indeed, is the malignity of this poisonous secretion, that its effects in destroying the life of a wounded insect are almost instantaneous, and in the case of some large species, even small birds fall victims to its virulence.

FIG. 147.—FANG OF SPIDER.

One peculiar characteristic of spiders, as we have already stated, is the possession of a spinning apparatus, whereby the threads composing their web are manufactured. The apparatus employed for this purpose is situated upon the hinder part of the abdomen, and consists externally of four *spinnarets*, from which delicate threads, represented in the accompanying figure, are produced.

Each spinnaret when highly magnified is found to be perforated at its extremity by innumerable orifices

of exceeding minuteness, through which the filaments are drawn. The fluid silk, which constitutes the

FIG. 148.—GARDEN SPIDER.

material whereof the thread is composed, is secreted by a set of glands, situated in the interior of the body. Unlike the single line of a caterpillar, the thread of the spider, delicate as it is, is seen to be composed of hundreds of filaments, sometimes woven together by zigzag lines, and thus exhibiting a structure of exquisite and most elaborate composition.

Various are the purposes to which the different species of spiders convert the delicate threads thus produced. Some construct silken tubes or cells in which to conceal themselves, and from this retreat they issue to hunt for prey, in the vicinity of their abode. Others throw their filaments about at random, apparently to entangle passing insects.

Many make nets composed of regular meshes, and spread them in favourable situations to entrap their victims; while some species, enveloping their eggs in bags of curious construction, carry them about attached to their bodies, and defend them with the utmost courage and pertinacity. Even in water these webs are turned to many singular uses: and ropes, nets, and even diving-bells are at the disposal of aquatic species, furnished with this extraordinary spinning machinery.

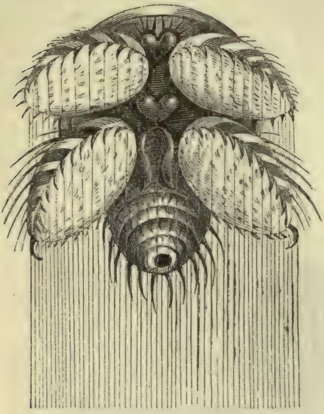


FIG. 149.—SPINNING APPARATUS OF THE SPIDER. (*Greatly magnified.*)

Spiders are divided into the following families, each of which will require our notice:—

The **Mouse Spiders** (*Mygale*).* In these the eyes are always placed at the anterior margin of the cephalothorax, and generally close together. Their palpi and their feet are very robust. They are generally furnished with four spinnarets, with which they fabricate silken tubes, that serve for their habitations; they are sometimes found under stones or under the bark of trees, or hidden between leaves tied together.

To this group belongs the celebrated **Bird Spider** (*Mygale avicularia*), the body of which is upwards of an inch and a half in length. It manufactures its tube of a tissue so strong and dense, that it resembles white muslin, and carries its eggs in a cocoon of the same material, as large as a walnut. That these formidable creatures are able to kill and live upon birds, as their name indicates, has been disputed. The question has now, however, been set at rest.

Mr. H. W. Bates, who for many years had an opportunity of observing their habits on the Amazon, writes as follows:—"In the month of June, 1849, in the neighbourhood of Cameta, I was

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* μυγαλῆ, mygale, *a field-mouse.*

attracted by a curious movement of the large grey-brown Mygale on the trunk of a large tree. It was close beneath a crevice or deep chunk in the tree, across which this species weave a dense web. In the present instance, the lower part of the web was broken, and two pretty little finches were entangled in its folds, one of them was quite dead, but secured in the broken web; the other was under the body of the spider, not quite dead, and was covered in part with the filthy saliva of the monster. As I was returning from a day's excursion at the time, with my boxes full of valuable and delicate insects, and six miles from my house, I could not have brought the specimens home, even if I had wished, which I did not, as the species was very common and easily procured. On the extensive plains of Santarem there are hundreds of their broad slanting burrows. These localities are almost destitute of insects, but they swarm with small lizards and birds, upon which the Mygale seems to feed."

The **Mason Spiders** (*Mygale cementaria*) excavate for themselves subterranean caverns wherein these marauders lurk, secure from detection, even by the most watchful foe; nor could any robber's den that ever existed in the wild regions of romance, boast more sure concealment from pursuit, or immunity from observation. The construction of these singular caverns has long excited the admiration of the naturalist. A deep pit is first dug by the spider, often to the depth of one or two feet, which being carefully lined throughout with silken tapestry, affords a warm and ample lodging. The entrance to this excavation is carefully guarded by a lid or door, which moves upon a hinge, and accurately closes the mouth of the pit. In order to form the door in question, the Mygale first spins a web, which exactly covers the mouth of the hole, but which is attached to the margin of its aperture by one point only of its circumference. This point, of course, forms the hinge. The spider then proceeds to spread upon the web a thin layer of the soil, collected in the neighbourhood of her dwelling; this she fastens with another stratum of silk; layer after layer is thus disposed, until at length the door acquires sufficient strength and thickness. When perfected, the concealment afforded is complete, for as the outer layer of the lid is formed of earth precisely similar to that which surrounds the hole, the strictest search will scarcely reveal to the most practised eye the retreat so singularly defended.

FIG. 150.—TRAP-DOOR SPIDER.

As might be expected, there are varieties in the shape and size of these nests. Some specimens, obtained in the island of Zante, have the silken layers of the lid extended into a sort of handle or lever just above the hinge, on pressing which the trap-door opens.

The spiders possessing but one pair of respiratory sacculi constitute the genus of **Spinning Spiders**

FIG. 151.—NEST OF TRAP-DOOR SPIDER. FIG. 152—TRAP-DOOR OPENING BY A LEVER.

(*Aranea*), so called on account of the perfection of their webs, the first named of the race, of course, being Miss Arachne, who was turned into a spider

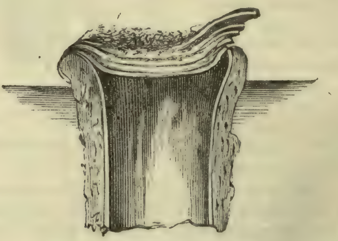

FIG. 153.—SECTION OF NEST.

for having challenged Minerva to a spinning-match. These are divided, according to their habits, into

The **Sedentary Arachnidans,** distinguished by weaving webs, or, at least, casting out threads in order to entrap their prey, whilst they remain concealed in the vicinity of their snares. These have eight eyes, two or four of which are placed in the middle of the forehead, and the rest on each side.

Some species, which always walk straightforward, are called

Rectigrades (*Rectigrada*). They weave webs of different kinds, and hence have been divided into different families.

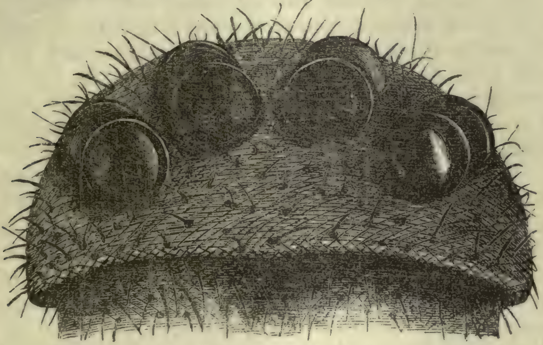

FIG. 154.—THE EYES OF SPIDER.

The **Tube-weavers** (*Tubiteles*), or Tapestry spiders, are celebrated for their ingenuity. The geometric web of the common garden spider (*Epeira diadema*) has been admired in all ages as a wonderful production, elaborate in its construction, and most effective for its purpose. These nets are composed of two sorts of threads. The framework, which is first formed, consists of straight rays diverging from a centre; these are not adhesive, but over these the spider then travels, weaving a spiral thread round and round, which is the true net; for this thread, which is more elastic than the other, is studded all over with minute globules of a gummy substance, by which it is rendered tenacious.

In Rio de Janeiro the family Epeira is characterized by many singular forms. Every path in the forest is barricaded with the strong yellow web of a species said to make nets so strong as to catch birds. A small but pretty kind of spider lives as a parasite upon every one of these webs; possibly it is too insignificant to be noticed by the great Epeira, and is, therefore, allowed to prey on the

minute insects which, adhering to the lines, would otherwise be wasted. When frightened, the little spider either feigns death, or suddenly drops to the ground. The web of another species of Epeira, which is generally placed among the great leaves of the Agave, is sometimes strengthened near the centre by two or even four zigzag ribands, which connect two adjoining rays. When any large insect, as a grasshopper or wasp, is caught, the spider, by quickly giving it a revolving movement, and at the same time emitting a band of threads from its spinners, soon envelopes its prey in a case resembling the cocoon of a silkworm. The spider now examines its powerless victim and gives the fatal bite on the hind part of its thorax, then retreating, waits till the poison has taken effect. The virulence of this poison is such, that in half a minute after being bitten a large wasp is quite lifeless.

The webs of another species, common in South America, are placed vertically, and separated from each other by a space of about two feet, but are all attached to certain common lines, which are of great length, and extended to all parts of the community; so that in this manner the tops of large bushes are covered by the united nets. These gregarious habits, in creatures so bloodthirsty and solitary as the spiders, are not a little curious.

Another American spider builds a web of very singular construction. Strong lines radiate from a common centre, where the creature is stationed, but only two of the rays are connected by mesh-work, so that the net, instead of being circular, consists of a single wedge-shaped segment.—DARWIN.

The *Clotho Durandii* constructs a kind of tent wherein it lives and rears its young. This tent is formed by several superimposed sheets of a material resembling the finest taffeta, and its margin presents seven or eight prominent angles, which are fixed to the surface of the ground by silken cords. The exterior sheet of the tent is purposely dirtied, for the sake of concealment, but all within is beautifully clean and white. The most admirable part of the contrivance, however, is the perfect safety afforded to the young when the parent leaves her nest in search of food. Some of the superimposed sheets are fastened together at their edges; others are simply laid upon each other; and as the spider herself only possesses the secret enabling her to raise those layers by which

entrance is to be obtained, no other animal can find its way into her impenetrable abode.

Another species is mentioned by Dr. Johnston, whose habits are still more singular. This spider lives habitually in and under water, but having no fellowship with that element, in which, of course, it cannot breathe like aquatic animals, in order that it may pass its life there in a dry and comfortable manner, appropriates to its use the old shells of *water-snails* (*Limnœus stagnalis*). Entering the shell, the spider closes the aperture with a web or curtain of varnished silk, which repels the water and hinders its admission; she then fills her abode with atmospheric air. The shell is sometimes found lying at the bottom of the pond, but, rendered buoyant by the air within it, often rises and floats on the surface, and the wily spider is, in this manner carried within reach of her prey, who feel no alarm at the approach of what seems to be a snail.

The **Spiders** (properly so called), (*Aranea*) belong to this group;

FIG. 155.—NEST OF HOUSE-SPIDER.

they build their webs in the interior of houses, in the angles of walls,

or on plants and hedges; sometimes under stones. Their web is very large, nearly horizontal, and in the upper part there is always a tube, in which the old spider sits concealed with immoveable patience until some heedless victim falls into her toils.

The **Water Spider** (*Argyroneta**) is another member of the same extensive family, the history of which must by no means be passed over. This remarkable spider lives in stagnant waters, where it swims about with perfect ease, keeping its abdomen enclosed in a bubble of air, which shines like a little globe of silver. The female constructs for herself a nest, a kind of diving-bell, in the shape of an oval cocoon, which is lined with silk, and anchored to the surrounding plants by cables spread in all directions; in this retreat she lies in wait for prey, and places her cocoon of eggs, which she jealously guards; and here, also, she shuts herself up to pass the winter.

The **Inequiteles,**† **or Thread-spinners,** constitute a second division, known by their webs, constructed of very irregular meshes, which cross each other in all directions. These spiders garotte their prey; they carefully watch their eggs, and never abandon them till they are hatched. Some of them (*Pholcus phalangista*) are common in our houses, where they construct a loose web in the angles of walls; the female glues her eggs together in a loose packet, without any covering, and carries them about in her jaws.

Upon one occasion, Bonnet saw a spider of this description tumble into the pit-fall of an ant-lion, which immediately seized upon her bag of eggs, and attempted to drag it into the sand. During the struggle, the silken cord whereby the cocoon was attached to the spider's body broke, immediately she seized it with her jaws, and a tremendous struggle ensued, during which the spider together with her treasure were buried beneath the sand, from whence, however, she was extricated; but nothing would induce or compel her to quit the dangerous locality where she had lost, apparently, everything that she held dear.

The **Orbiteles,**‡ or **Net-spreading** Arachnidans, construct their nets with regular meshes, concentrically arranged, and supported by straight cords that radiate from the centre, where the spider awaits the result of his labours, generally holding on to the web with his

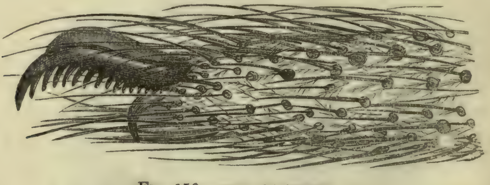

FIG. 156.—FOOT OF SPIDER.

head downwards. No sooner is an insect caught in the toïls, than the spider, sometimes placed in the centre of her net, sometimes

* ἄργυρος, argyros, *silver;* νητὸς, netos, *spun.*

† Inæqualis, *unequal;* tela, *a web.*

‡ Orbis, *an orb* or *disk;* tela, *a web.*

ensconced in some special hiding-place, situated in a corner of the web, rushes upon her victim, and endeavours to pierce it with her murderous fangs, and thus instil into its body a drop of the subtle venom with which they are armed. Should the imprisoned fly offer anything like a vigorous resistance, or should its strength appear formidable, she retires for a short time, till it is either exhausted by its struggles, or becomes helplessly involved in the meshes of the net; as soon, however, as she perceives there is nothing to fear, she at once envelopes her prey with coils of silk, so as entirely to conceal it from view. The eggs of these spiders are very numerous, agglutinated into a mass, and enclosed in a voluminous cocoon. The radiating lines of these webs are used by opticians in the construction of micrometers: they are so elastic, that they may be stretched one-fifth of their length.

The next group of Sedentary Arachnidans, instead of always walking forwards like the preceding, can walk sideways or backwards, equally well; they are, therefore, called

Laterigrades.* These spiders are generally found quite motionless upon vegetables, where they remain with their legs stretched out ready for action. They construct no web, but simply scatter about a few solitary threads to arrest their prey. Their cocoon is round and flat; they conceal it between leaves, the edges of which they fasten together, and carefully watch it until the eggs are hatched.

The second division of the race of spiders comprehends

The **Vagabond Arachnidans,** as they are called, in contradistinction to the preceding, which are all sedentary. These spiders make no web, but lie in wait for their prey, which they overtake by running, or by leaping upon it suddenly. They are divided into two sections—

The **Citigrades**, or *Runners*, and the **Saltigrades**, or *Leapers*.

The **Citigrades,**† called also **Wolf Spiders**, are to be found on the tops of trees or bushes, where they build a bell-shaped nest, in which the females lay their eggs: this nest, or cocoon, they always carry with them when they go to hunt, generally attaching it to their breast. Some of them are frequently seen by the margins of ponds; sometimes, indeed, they run upon the surface of the water with surprising swiftness, and they may be often seen to leap upon flies, and other insects that approach them too closely. One species—

The **Tarantula** (*Lycosa Tarentula*), so called from the city of Tarentum, in Italy, where it is common, has obtained great celebrity. It is there commonly believed that its bite is very serious, being sometimes fatal, or if not, that it occasions a peculiar malady called *Tarentism*, only to be cured by music and dancing. Enlightened and judicious persons are of opinion, however, that it is the effect of imagination that requires thus to be combated, rather than the venom of the Tarantula.

The **Saltigrade,**‡ or **Leaping Spiders**, may frequently be seen upon walls, or in other situations, exposed to the sun. They walk, as it were, by fits and starts, and after

* Latus, lateris, *the side;* gradior, *I walk.*

† Cito, *quickly;* gradior, *I walk.*

‡ Saltus, *a leap;* gradior, *I walk.*

taking a few steps, stop suddenly, and rear themselves on their fore-legs. Should they see a fly or gnat, they approach it cautiously, until they get so near that they can clear the distance at a single leap, and then spring like tigers on their prey. They may often be seen to make these leaps even from a perpendicular wall, for being always attached by a silken thread, they easily scramble up again. Many of them build their nests under stones, or between the leaves of trees. Their nests are of an oval form, and open at both ends: in these they repose, change their skin, or take shelter from the weather; but if alarmed, they immediately rush out, and scamper off with precipitation.

Some spiders possess the remarkable faculty of shooting out threads in diverging lines into the air, which, being lighter than the atmosphere, form a sort of balloon, on which the little æronaut mounts above this lower world, and rides at will among the clouds.

Mr. Blackwall supposes that the spider is enabled to do this by the action of the wind, which carries the thread out as it is spun, and that many being entangled together, are carried into the air by the upward current, caused by the rarefaction of the stratum near the heated ground, during the middle of the day; and that at night, the earth being cooled, the air descends, bringing with it the accumulated webs, which, lying thick upon the herbage, are called gossamer.

Mr. Darwin's observations relative to these gossamer spiders are very interesting. His ship was sixty miles from land, in the direction of a steady though light breeze, and vast numbers of small spiders covered the rigging with their webs.

"The little spider, when first coming in contact with the rigging, was always seated on a single thread. The little æronaut, as soon as it arrived on board, was very active, sometimes letting itself fall and then reascending the same thread, sometimes employing itself in making a small and very irregular mesh in the corners between the ropes. While watching some that were suspended by a single thread, the slightest breath of air bore them out of sight. I repeatedly observed the same kind of small spider, either when placed or having crawled on some little eminence, elevate its abdomen, send forth a thread, and then sail away in a lateral course, with a rapidity

which was quite unaccountable. I thought that I could perceive that the spider, before performing the above preparatory steps, connected its legs together with most delicate threads."

M. Virey has recorded some very curious observations (*Bulletin des Sciences Nat.* tom. xix. p. 130), which seem to prove that small spiders in an atmosphere perfectly tranquil, and without the aid of any web, have the power of darting through the air; and believes that, by means of a rapid vibration of their feet, they *walk the air.*

"After reading M. Virey's account," says Mr. Darwin, "it appears to me far from improbable that, in the case above recorded, the little æronaut actually did as was suspected, unite its feet together with some fine lines, thus forming artificial wings. I regret that I did not determine this point with accuracy; for it would be a curious fact that a spider should thus be able to take flight by the aid of temporary wings."—*Voyage of the 'Beagle.'*

CHAPTER XIII.

CRUSTACEA.

THE Insects and Arachnidans described in the preceding chapters are air-breathing animals: even in such species as inhabit fresh water, respiration is strictly aërial. No insects or spiders could live in the sea, and, consequently, the waters of the ocean would be utterly untenanted by corresponding forms of life, had not a class of beings belonging to the articulated division of the animal world been so constructed as to be capable of respiring through a watery medium, and thus adapted to a residence in the recesses of the deep. Many species, it is true, are met with abundantly in the fresh waters around us; but these form rather exceptions to the general rule, and we may fairly regard the crustaceans as marine representatives of the insects and spiders, with which they form a parallel series. These animals are divided into segments, typically twenty-

one in number, of which seven belong to the head, seven to the thorax, and seven to the abdomen. The segments, however, are generally consolidated or soldered together in various degrees, so that in the great majority of cases, only a few of these divisions are obvious. Thus, in the lobster, the whole head and thorax are united into one great shield, on the under side of which, however, the divisions can be traced; in the crab the consolidation of these parts is still further conspicuous, and the segments of the abdomen are small, and folded up beneath the enormous thorax; while in the remarkable king-crab or "*horse-foot*" of warm climates (*Limulus*), the divisions of the abdomen are lost, the body being covered by two large shields, terminating in a long, sharp spine. The higher forms of crustaceans breathe by means of gills, and when these organs are wanting, the integument of certain parts of the body, generally of the limbs, takes their place. In the crabs, lobsters, and shrimps, respiration is effected by a number of *branchiæ*, attached to the basis of the locomotive limbs. The structure of these gills is very curious; they consist of a central stem, to which are attached numerous appendages, disposed like the bristles of a brush, or else piled on each other like the leaves of a book, thus presenting in the aggregate a very extensive surface for exposure to the surrounding element. These organs are enclosed in two large chambers, situated on the sides of the thorax, into which the water is freely admitted by a wide aperture, situated between the bases of the legs and the margin of the shell, and expelled through another orifice, placed at the side of the mouth. In order to insure the renewal of the respired water, a valve of beautiful construction is placed in the vicinity of the latter opening, and attached to the root of the second pair of foot-jaws. The construction of this valve is precisely that of the Archimedean screw, or of the propelling laminæ of a screw-steamer, so that by its every movement it

drives a powerful current through the opening in which it is situated. In other crustaceans, such as the Mantis Crabs, the gills have the form of bunches of feathers, and instead of being enclosed within the thorax, float freely from the false feet situated beneath the tail. In many of the lower forms, the breathing organs consist of little bladders, fixed to the bases of the legs, while in others, the limbs themselves are so thin and delicate that they seem to afford a sufficient respiratory surface.

There are, however, some families of Crustaceans which live upon dry land, and thus respire the atmospheric air, and these would seem to form an exception to what has been said relative to the difference of structure in the respiratory apparatus of aquatic and terrestrial animals, for instead of being furnished with tracheæ, like the insects, they breathe air by means of gills: these, however, are always disposed in such a manner as to be kept in the moist state required for the exercise of their function. In these terrestrial species, therefore, which breathe by means of *wet gills*, there exists at the bottom of the respiratory cavity a sort of trough, which serves as a reservoir for water sufficient to keep their branchiæ moist, or else the respiratory cavity is lined with a spongy membrane, which seems to answer the same purpose. Others, again, as the wood-lice (*Oniscus*), breathe a damp atmosphere, by means of foliaceous appendages, situated under the abdomen.

The crustaceans are all oviparous. The female, after having laid her eggs, generally carries them about attached to the under part of her body, or sometimes inclosed in a sort of pouch formed of appendages variously modified. Sometimes the young undergo a very remarkable metamorphosis, and not only completely change their form during the earlier periods of their existence, but in the progress of their growth acquire additional limbs.

All the senses of the higher animals are possessed by the **Crustacea** in considerable perfection. The

organs of vision are present in all at some period of their existence, and in the majority of species are of a very complex structure. We find in some both simple and compound eyes, similar in principle to those of insects; both of these forms occur in the king-crab (*Limulus*), and there are eyes of an intermediate character, such as that of the water-flea (*Daphnia*), where several clustered lenses and eye-cells are covered by a single smooth and transparent *cornea*. But in the higher forms of crustacea, the true compound or faceted eye only, is met with. The facets are not always six-sided, as in insects, but are sometimes square, as in the cray-fish (*Astacus fluviatilis*). Sometimes the eyes are immoveable; but in many species they are placed at the end of jointed foot-stalks, of various length, capable of being pointed in different directions; and we often find, in connection with these stalked eyes, a furrow, in which they can be laid flat, and thus protected from injury. The organ of hearing is a cavity closed by a delicate membrane, situated at the base of the second pair of antennæ, in the lobster and similar forms. In the crabs this is replaced by a small, moveable, shelly disk, pierced with a hole, over which an elastic membrane is stretched. A cavity filled with fluid in each case conveys the vibrations of sound to the proper nerves.

There can be little doubt that the higher **Crustacea** are guided to their food by a sense analogous to that of smell; but where its seat is placed, zoologists have not determined; the probability is, that it may be connected with the first pair of antennæ. Similar observations may be applied to the perceptions of taste; the sense doubtless exists, and its organ is supposed to be the delicate membrane that lines the mouth and the throat. It is commonly considered that the sensations of touch can be but very feebly, if at all, conveyed through the hard, calcareous crust with which these animals are clothed; and that this sense can hardly exist, except in those parts

which remain soft and undefended by the crust. But we have seen a swimming-crab (*Matuta*) hold its prey in one claw, while with the other it picked off morsel by morsel of the flesh, and conveyed it to its mouth in a manner which sufficiently evidenced the sensation of touch in these organs; and we have watched a beautiful West Indian crab (*Goniopsis ruricola*) feeding itself in the same manner, picking up, now with one claw, now with another, minute atoms of food from the surface of the mud over which it marched, with a rapidity and a precision which seemed to indicate that a very delicate sense of touch resided in those shelly claws.—MR. GOSSE.

The periodical casting of the shell, or moulting, is a very remarkable feature in the economy of these creatures. Frequently during their lives their hard and shelly covering is cast off in one unbroken piece, so as to present an exact counterpart of the perfect animal. Every part of the integument is thus renewed, nothing is wanting in the cast-off skin, the antennæ, the jaws, the eyes, are all there, every hair is represented by the case which enclosed it. Even the shelly plates from which the muscles originate, the tendons by which they are attached to the shell, the internal skin of the stomach, and the teeth which are hidden there, are found connected with the rejected shell!

The pressure of the old shell being removed, the animal suddenly increases in bulk, the new skin, as yet soft and flexible, allowing at first of great expansion; but it rapidly hardens, a stock of shelly matter having been for some time accumulating in its stomach, in the form of two hard balls, commonly called *crabs'-eyes*. This substance is supposed to be taken up and distributed to the surface, so that when the new crust has again acquired consistence, these concretions are no longer found. The whole process occupies from one to three days. The supposition that the moulting in these animals takes place every year, must probably be restricted to the period of

their growth beyond which the change of shell would seem to be unnecessary. A specimen of the common crab has been taken, the shell of which was covered

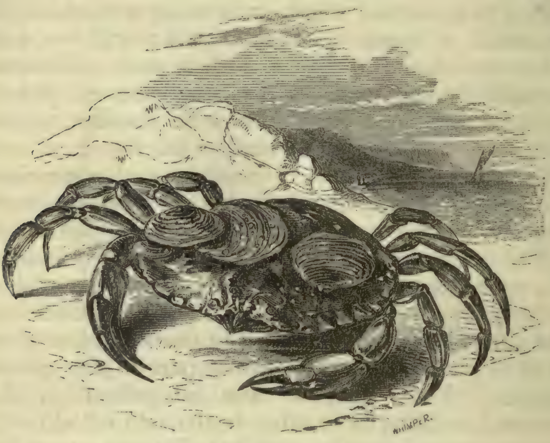

FIG. 157.—CRAB COVERED WITH OYSTERS.

with oysters of six years' growth, besides *Actiniæ* and other parasites. The crab was full-grown and in perfect health, and it is clear that it could not have cast its shell for six years previously.

The external forms and structure of the limbs of crustaceans are infinitely diversified; but as they are all constructed in accordance with the same plan, we will select the lobster for special description, as illustrative of the entire group.

On examining a lobster with a little attention, it will be seen that its head is furnished with *four* antennæ, a circumstance which is distinctive of the class. Its eyes are compound, like those of an insect, and are supported upon a pair of moveable pedicles. There are five pairs of jointed limbs placed on each side of the mouth, which are evidently adapted to assist in seizing and conveying into the mouth the substances used as food.

These singular organs, although entitled to be considered as jaws, so far as their use would indicate, are no less obviously merely modifications of jointed feet; they are, therefore, termed "foot-jaws."

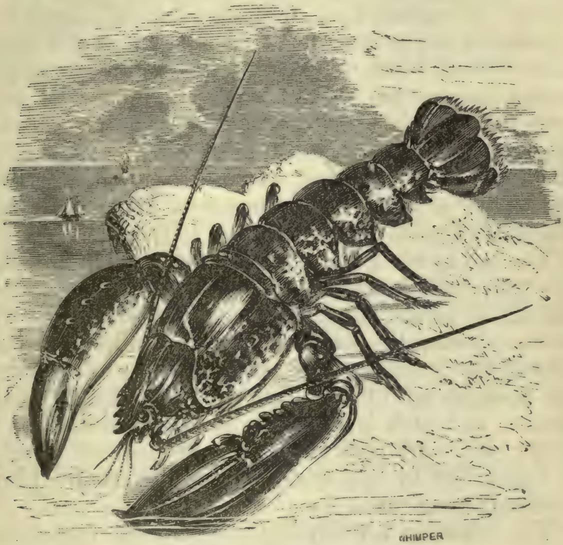

FIG. 158.—COMMON LOBSTER.

The pair of legs which comes next are developed to a size far surpassing that of the other limbs, and are endowed with proportionate strength. Each of these robust extremities is terminated by a pair of strong pincers (*chelæ*); but the two differ in their structure, and are appropriated to different uses. That of one side of the body has the opposed edges of its terminal forceps provided with large, blunt tubercles, while the opposite claw is armed with sharp teeth. One claw, in fact, is used as an anchor, by which the lobster holds fast by some submarine fixed object, and thus prevents itself from being tossed about in an agitated sea; the other is a cutting instrument for tearing and dividing prey.

To the *Chelæ* succeed four pairs of slender legs, scarcely at all serviceable for locomotion, but the two anterior being terminated by feeble forceps, are auxiliary instruments of prehension.

The articulated appendages situated beneath the tail are so rudimentary, that they are no longer recognizable as instruments of progression, and it is at once evident, when we examine the manner in which these creatures use their tails in swimming, that any large limbs in this position would materially impede the movements of animals presenting such a construction. The *false feet*, as these organs are called, are merely available as a means of fixing the eggs which the female lobster attaches to them.

The tail is the great agent of locomotion, and for this purpose it is terminated by a fin formed of broad plates, so arranged, that while they will close together during the extension of the tail, and thus present the least possible surface to the water, they are brought out to their full expansion by its down stroke; and such is the impulse thus given, that a lobster will dart backwards to a distance of twenty or thirty feet by one sweep of this remarkable locomotive instrument.

The **Crustacea** are divided into several important sections, each of which will require separate notice.

The first great division of this extensive class has received the name of

Decapoda* (*ten legs*), from the circumstance that their locomotive limbs are always *ten* in number. The Decapods are divided into three groups, known by the somewhat unpronounceable names of **Macroura, Brachyura,** and **Anomoura**; when translated into English, however, these formidable looking words simply mean **Big-tails, Little-tails,** and **Queer-tails.**

The division **Macroura**† (*big-tails*), includes the *Lobsters, Cray-fishes, Shrimps,* and *Prawns.*

* δέκα, deca, *ten*; πόυς, ποδὸς, pous, podos, *a foot.*

† μακρὸς, macros, *long*; ουρὰ, oura, *a tail.*

The **Sea Cray Fishes** (*Palinurus*) have their antennæ very large, and studded with sharp spines; their shell is likewise rough, covered with prickles, and armed in front with strong spiny protuberances. They seldom frequent any but rocky or stony places, live there on fish and divers marine animals, and attain, after some years, to the length of a foot, measured from the head to the extremity of the tail. In some places, little favourable to fishing, these crustaceans, being less exposed and more tranquil, may live a very long time, and acquire a large size; some have been obtained nearly three feet long. They are caught in wicker baskets, baited with flesh, much in the same way as lobsters.

The **Lobsters** (*Astacus*) are distinguished by having their front pairs of slender feet terminated by a kind of forceps or two-fingered hand. These well-known animals are abundant throughout the European seas, in the Mediterranean, and upon the eastern coast of North America.

The **River Cray Fish** (*Astacus fluviatilis*), common throughout Europe in every clear brook, is easily caught by means of a net attached to an iron ring, in the middle of which a piece of meat is fixed; the iron circle is attached to a long stick by means of three strings. It is put into the water at dusk, the time at which the cray-fishes quit their holes, and before long they are sure to find the meat, which they rush at with great avidity. The net is then suddenly raised, and several are caught at once. Sometimes the plan is modified by placing the meat in the centre of a faggot of thorns, the cray-fishes in endeavouring to get at it become entangled among the branches, and when the faggot is drawn out a dozen or two may be taken at a single haul.

The **Prawns** (*Palæmon*) are marine crustacea, which, in the summer-time, frequent the mouths of rivers; they are fished for by means of a net in the form of a sack attached to the end of a pole, or with large nets with close meshes, which are thrown to a distance into the sea, and bring them to the shore in great multitudes.

Mr. Warrington has published many interesting observations on the natural history of the Prawn. When the period arrives at which the prawn is about to throw off its old covering, it ceases to feed, and seeks about from spot to spot in a restless and fidgety manner, until it has fixed on a locality suited to its purpose. The third, fourth, and fifth pair of legs are then stretched out wide apart, and the feet hooked so as to hold firmly upon the surrounding substances, in such a way that the body may be poised and capable of moving freely in all directions. The prawn then slowly sways itself from side to side and to and fro with strong muscular efforts, apparently for the purpose of loosening the whole surface of its body from the carapace; and when every precaution has been taken for the withdrawal of its body from the too limited habiliments, a fissure is observed to take place between the carapace and the abdomen, at the upper and back part, and the antennæ, legs, feet, and all their appendages are slowly and carefully drawn backwards out from the dorsal shield until the eyes are quite clear of the body-shell or carapace. The prawn, thus half released, then makes a sudden backward spring or jerk, and the whole of the exuvium is left behind, generally adhering by the cases of the six feet to the surface

selected as a support. At the moment the prawn has been thus liberated from its old envelope, it rolls on the surface of the ground perfectly helpless, for it is so soft that it does not possess the power of supporting its own weight erect upon its feet, while the beautifully delicate antennæ float from its head like gossamer threads in the water. In a short time, however, it plunges or springs from place to place, stretches its webbed tail, and the large paddles of its swimming apparatus, and soon retreats into some dark and sheltered corner until its new shell is sufficiently hardened to allow of its venturing forth. When the newly-coated shrimp first makes its exit from its hiding-place its appearance is doubly beautiful; and the deportment of the little creature is altogether so bold and vain-glorious, as though proud of its new vesture, that it cannot but command the admiration it seems to seek.

The **Shrimp** (*Crangon*). The common Shrimp (*Crangon vulgaris*) does not exceed two inches in length, and is of a pale glaucous green colour dotted with grey. During life the body is semi-transparent, and so much resembles sea-water that the animal is distinguished with difficulty. Its ordinary motion consists of leaps. It is abundant in sandy places on the coast, and besides furnishing nutriment to great numbers of fishes, aquatic birds, &c., it is in great request for the table. Shrimp-catching, or *Shrimping* as it is termed, affords constant employment on the flat sandy parts of our coast to boys and women, who wade up to their knees pushing a sort of dredge-net at the end of a long pole before them, but a more wholesale way of collecting them is by means of sweep-nets, dragged over the fishing-ground by men in boats.

Brachyura,* or **Crabs.** These creatures are formed for progression on land, or at least for creeping on the bottom of the sea. The tail, the great instrument of locomotion in the lobster, is in the crabs reduced to a rudiment, and the fin at its extremity entirely obliterated. The *chelæ* still continue to be the most powerfully developed of the limbs, while the legs, now become the principal locomotive agents, are either terminated by simple points, as in those species which are most terrestrial in their habits, or else, as in the swimming crabs, the posterior pair become expanded into flattened oars, useful in natation.

The habits of crabs are very various; some are exclusively aquatic, and remain on the sands or rocks at great depths in the sea; others inhabit excavations formed in the soft coral reefs or bars on certain coasts; some spend their days altogether on a shore, living in burrows or dens formed in a moist

* *βραχύς*, brachys, *short; οὐρά*, oura, *a tail.*

or boggy soil; others resort to the rocky flats or beaches to bask in the sun, where only an occasional wave dashes over them, and seek refuge in the sea when alarmed; while some species are completely terrestrial, inhabiting holes upon the highest hills and mountains of the West Indies.

The **Spider Crabs** (*Oxyrynchus*)* have their shells of a triangular shape, narrowed in front into a point which almost resembles a beak. The legs are long and very slender, this necessarily leads to slowness of motion; but they are well fitted to a residence amongst rocks and stones covered with seaweed, among which they stride with little difficulty. In the winter they become almost, if not altogether, torpid, concealing themselves at this season either in deep crevices of rocks or imbedded in the soil. These long-legged crabs are frequently covered with seaweeds, sponges, and other marine productions, which so completely change their appearance, that they are no longer recognizable. Mr. Gosse observed at Ilfracombe the exuviation of a large Spider Crab which had retired into a crevice. When securing it he felt the body fall away from the carapace, and on looking at the crab, found the new carapace perfectly formed and coloured beneath it. The limbs and the under parts still remained invested with their old shell. In a short time the hind legs were freed, and then the animal extricated the front pair, tugging first at one and then at the other as if drawing off a pair of boots. The parts had a jelly-like softness, and seemed to be compressed as they were liberated by the fluids being forced back so as to distend the freed portion of the limb. Mr. Gosse did not observe any struggling—it seemed a very simple and easy matter. The new integuments were complete, though soft, before the old were torn off; and the immediate cause of the separation of the crust appeared to be the sudden growth of the animal within forcing asunder the upper and lower shells at the posterior margin.

The **Swimming Crabs** (*Pinnipedes*)† have the hinder feet terminated by a flat joint resembling a fin. They live at a distance from the shore, and swim out into the high sea.

The **Shore Crabs** (*Cancer*) are eminently adapted for walking. The eight hinder legs only are employed for the purpose, and they

FIG. 159.—YOUNG OF CRAB.

* *οξύς*, oxys, *sharp; ῥύνχος*, rhyncos, *a snout.*
† Pinna, *a feather* or *leaflet;* pes, pedis, *a foot.*

are terminated by strong and pointed claws. They walk with the same facility forward or backward, on one side or the other, or in all oblique directions; they also climb with great celerity.

The **Edible Crabs** (*Pagurus*), well known at our tables, generally frequent rocky coverts, and hide in the clefts of rocks, where they are sheltered from the waves, and secured from the pursuit of their enemies. When the waters rise, they approach the shore and seize on marine animals incapable of resistance, or devour such as have perished. It is principally during the night that they proceed to plunder. As they do not always regain the sea with sufficient promptness, and they cannot swim, they are often exposed to be stranded at the retreat of the tide. Under such circumstances, if they do not find a hole to take refuge in, they contract their feet, squat down in some corner, and thus await with patience the return of the water. Crab-fishing is usually conducted by two men, in a boat provided with lines and *creels*, *cruives*, or *crab-pots*, as they are

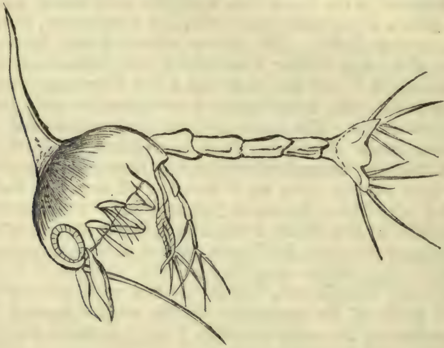

FIG. 160.—FIRST STAGE OF SHORE-CRAB.

variously called, made of a kind of osier basket-work. These are constructed upon the same principle as a wire mouse-trap, but the aperture instead of being on the side is at the top. The bait, which consists of stale fish, is fastened to the bottom, and the creel is then sunk in a favourable situation, by stones of sufficient weight placed within it; a line is fastened to the creel, to the upper end of which a cork is attached. The bait can readily be seen by the crabs, which entering, are caught like rats in a trap; the difficulty of egress being increased by the aperture being overhead.

Crabs undergo a remarkable metamorphosis. On leaving the egg, their larvæ have a very grotesque appearance. They are furnished with a large, helmet-shaped head, ending behind in a long point, and provided in front with two monstrous sessile eyes, like the windows of a lantern. By means of a long, articulated tail, the little creatures continually turn head over heels. Claws are as yet wanting, and the young crab has only four pairs of legs, armed with long bristles, that push food towards the ciliated and ever-active mouth. Immediately after casting its first skin, the body makes an

approach to its future permanent form, the eyes become raised on stalks, the claws and feet begin to make their appearance, but the tail still remains like that of a lobster, and is used by the young crab to swim about merrily in the water. It is not until the next

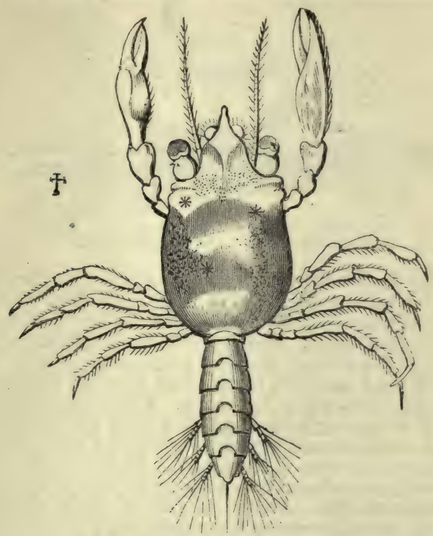

FIG. 161.—SECOND STAGE OF SHORE-CRAB.

moult, when the little creature measures about one-eighth of an inch in diameter, that the mature form is completely developed. The facility with which these crustaceans cast off their legs, and even their heavy claws, when they have been wounded, is a most remarkable feature in their economy. Without the least appearance of pain, they continue to run about upon their remaining legs, and, wonderful to relate, after some time a new limb grows out of the old stump, and takes the place of the original member. When the old claw is separated, a scar forms, and remains until the animal casts its shell. After the shell is thus cast, a protuberance in the centre of the scar suddenly enlarges, and under it may be seen a small claw, doubled on itself beneath the membrane of the stump. This remains in a soft state until the crab again casts its shell, when the new claw is set at liberty, straightened out, and becomes hard and calcareous, like other parts of the body.

The **Rider or Racer Crabs** (*Ocypoda*),* found on the coasts of Syria and Barbary, run so quickly that a man on horseback is said not to be able to overtake them. The West Indian species dig holes three or four feet deep, immediately above high-water mark, and only leave them after dusk.

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* *ὠκύς*, okys, *swift ; πόυς, ποδός*, pous, podos, *a foot.*

The **Beckoning Crabs** (*Gelasimus*)* have one of the claws, sometimes the right, sometimes the left, much larger than the other, and the pincers of the smaller forceps shaped like a spoon. These

FIG. 162.—THIRD STAGE OF SHORE CRAB.

creatures live in burrows, which they excavate upon the sea-shore, and close the entrance by means of their large claw, the disproportionate size of which is thus found to be a wonderful and beautiful adaptation to their habits. Their burrows are cylindrical, and carried obliquely into the ground to a very considerable depth. They are met with in great numbers, placed close together, but are usually inhabited each by a single individual. From these crabs having the habit of flourishing their large claw as if they were beckoning to some one at a distance, they have received the name of "**Calling Crabs**" (*Cancer vocans*). They pass the winter in their burrows, without stirring abroad, and only visit the sea to lay their eggs.

The **Cocoa-nut Crab** (*Birgus*) is said to climb the cocoa-nut palms for the sake of procuring their fruit; but Mr. Darwin says that it merely lives upon those that have fallen upon the ground. Its front pair of legs is terminated by very strong and heavy pincers, the last pair by forceps which are narrow, and of a weaker structure. After having selected a nut fit for its dinner, the crab begins its operations by tearing off the husk, fibre by fibre, from that end where the three holes are situated; it then hammers upon one of them with its heavy claws, until an opening is made, through which, by means of its hinder pincers, it extracts the white, albuminous substance of the nut. It inhabits deep burrows, where it accumulates surprising quantities of picked cocoa-nut husks, on which it rests as on a bed. Its habits are diurnal, but every night it is said to pay a visit to the sea for the purpose of moistening its branchiæ. It is very good to eat, and the fat accumulated under the tail of the larger ones sometimes yields a quart of oil.

Dr. Gardner, in his "Travels in Brazil," says that while he was near Rio San Francisco, he amused himself with watching the operations of a small species belonging to the genus *Gelasimus*, that was either making or enlarging its burrow in the sand. About once in every two minutes it came up to the surface with a quantity of sand enclosed in its left claw, which, by a sudden jerk, it ejected to a distance of about six inches, always taking care to vary the direc-

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* γελάω, gelao, *to laugh at or ridicule.*

tion in which it was thrown, so as to prevent its accumulation in one place.

Another species, which inhabits India, is thus noticed by Bishop Heber in his journal: "All the grass through the Deccan generally swarms with a small land crab, which burrows in the ground, and runs with considerable swiftness, even when encumbered with a bundle of food as big as itself; this food is grass, or the green stalks of rice, and it is amusing to see the crabs, sitting, as it were, upright, cut their hay with their sharp pincers, and then waddling off with their sheaf to their holes as quickly as their sidelong pace will carry them. They have been found on the table-lands, at an elevation of nearly 4000 feet; but it is believed that they do not perform an annual pilgrimage to the sea, for the purpose of depositing their eggs."

Most probably they prefer fresh water.

The **Land Crabs** (*Gecarcinus*)* inhabit the West Indies and other warm countries. These crabs, instead of frequenting the sea, as most crustaceans do, are essentially terrestrial, and they sometimes live at a considerable distance from the shore. They nevertheless avoid extremely dry situations, and are ordinarily found in marshy districts. They all dig deep holes. They are commonly seen at night, or just after abundant rains, when they sally forth in crowds from their subterranean habitations in pursuit of food; some species live principally on vegetables, but others seek animal food with avidity; great numbers are found in cemeteries. One of the most curious points in the history of these animals is that they make an annual journey to the sea-shore. In the rainy season they abandon their holes; they assemble in almost numberless troops; and, guided by an instinct which is incomprehensible to us, take a direct line towards the sea, although they are often very distant from it. They travel chiefly by night, and nothing but large rivers can arrest or turn them from their route; they march over houses, scale rocks, and often destroy whole plantations, cutting and devouring the young plants as they pass along. Having reached the sea, these armies of crabs plunge in and bathe several times, and then retire to the plains or neighbouring woods. Some time afterwards the females go again to the sea, and there deposit their eggs; then they resume their march and return to their ordinary abode; but are so thin and feeble that they can scarcely drag themselves along.

Some of these crabs take up their abode in the vicinity of sugar-cane fields, and are very injurious to the planters; some of the species being particularly fond of the cane, the juice of which they suck, and chiefly subsist on. They are of course narrowly watched, and no opportunity of catching them is lost sight of; but such is the wonderful facility they have in running, or rather darting, in any direction, or with any part of their bodies foremost, that they are almost always enabled to elude capture. It is seldom, moreover, that they go far from their burrows in the daytime, and their vigilance is such that they regain them in a moment, and disappear securely as soon as a man or dog comes near enough to be seen.

If we now pass to the consideration of the

* γῆ, ge, *the earth;* καρκίνος, carcinos, *a crab.*

Queer-tailed Decapods (*Anomoura*), we find that the limbs above enumerated, although existing in precisely similar situations as in the lobster, are so far modified in their construction and relative proportions, as to become suited to a mode of life widely different from that led by the members of the last division.

The **Anomoura**,* as their name imports, have limbs of very anomalous conformation. Instead of being cased in a hard coat of mail, the hinder part of the

FIG. 163.—SOLDIER CRAB, OCCUPYING AN EMPTY SHELL.

body is soft and leathery, possessing only a few detached shelly pieces, comparable, it is true, to those found in the lobster, but strangely altered in structure.

These animals, usually known by the name of **Soldier Crabs**, or **Hermit Crabs**, frequent level and sandy shores; and from their defenceless condition are obliged to resort to artificial protection. This they do by selecting an empty shell, generally

* ἄνομος, anomos, *lawless*; οὐρα, oura, *a tail*.

that of a whelk, of proportionate size, into which they insinuate their tail, and retreating within the recesses of their adopted abode, obtain a secure retreat, which they drag after them wherever they go, until by growing larger, they are compelled to leave it, in search of a more capacious lodging. The wonderful adaptation of all the limbs to a residence in such a dwelling, cannot fail to strike the most incurious observer. The *chelæ*, or large claws, differ remarkably in size, so that when the Hermit Crab retires into its concealment, the smaller one may be entirely withdrawn, while the larger closes and guards the entrance. The two succeeding pairs of legs, unlike those of the lobster, are of great size and strength; and instead of being terminated by pincers, end in strong pointed levers, whereby the animal can not only crawl, but drag after it its heavy

FIG. 164.—SOLDIER CRAB REMOVED FROM ITS SHELL.

habitation. Behind these locomotive legs are two feeble pairs, barely strong enough to enable the Soldier Crab to shift its position in the shell it has chosen, and the false feet attached to the abdomen

are still more rudimentary. But the most singularly altered portion is the fin at the end of the tail, which here becomes transformed into a kind of holding apparatus, by which the creature retains a firm grasp upon the interior of its residence.

SECOND ORDER OF CRUSTACEANS.

STOMAPODA.*

The **Stomapoda** (*Mouth-footed Crustaceans*) are so called, because their feet are collected in the immediate vicinity of the mouth. In this order the principal organ of locomotion is the tail, which broadly spread, and armed with a beautiful expansion at its extremity, carries beneath it the false feet, here developed into five pairs of broad leaf-like organs, which constitute the instruments of respiration. The integuments of the Stomapodes are thin and almost membranous.

The **Mantis Shrimp** (*Squilla mantis*) is remarkable on account of the strange resemblance between its fore-legs and those of the insect Mantis, described in a preceding chapter. Its carapace covers only the anterior half of the thorax; the hinder portion being formed of rings like those of the abdomen. It is provided with enormous claws, terminating in a sharp hook; the last joint furnished with six sharp projecting spines, and the preceding joint with three, and so hollowed as to render this claw a most efficient instrument of prehension. The other foot-jaws, and the three anterior pairs of thoracic members, share in this conformation, and serve to hold the prey against the mouth. The three posterior pairs of legs, which are attached to the annulated portion of the thorax, are furnished with a brush instead of a hook at their extremities, and more resemble the abdominal

* στομα, stoma, *the mouth;* πόυς, pous, *a foot.*

swimming-legs. The tail is expanded into a broad fin. By the nature of its conformation we see that this animal is adapted both for seizing and holding

FIG. 165.—MANTIS SHRIMP.

its prey, as well as for swimming, but not at all for walking.

Dr. Lakis has published the following observations on the habits of a specimen that he kept alive in a basin of sea-water for two days:—"It sported about, and exhibited a boldness rather unexpected. When alarmed it sprang backwards with great velocity, after which it placed itself in a menacing attitude. The prominent appearance of the eyes, their brilliancy and attentive watching, the feeling power of the long antennæ, evinced quick apprehension and instinct. I brought a silver spoon near them, which was struck out of my hand, with a suddenness and force comparable to that of an electric shock. This blow was inflicted by the large arms, which were closed and projected in an instant with the quickness of lightning. An apparent anxiety to keep the head and claws in front, made me suspect that the animal lodges its hinder parts in holes or recesses, from which it can strike at its prey, or other passing objects."

The **Opossum Shrimps** (*Mysis*) have their branchiæ sometimes attached to the abdominal legs, sometimes to the thoracic legs, but they are never enclosed within the carapace. These animals have received

the name of Opossum Shrimps from the curious pouch, formed of plates attached to the abdominal legs, in which the female protects both her eggs and young until the latter have attained considerable development.

The Opossum Shrimps abound in the northern seas. The Arctic Ocean teems with myriads, forming, not troops, but vast clouds, spreading over square leagues of water, and affording sufficient and most nutritive food for the whale, and for the prodigious shoals of salmon that visit the shores of Boothia during July and August, and upon which the inhabitants of that dreary region depend in a great measure for their supply of winter provisions. During summer the Opossum Shrimps absolutely crowd the mouths of the rivers, and there their destroyers revel in a continual feast.

FIG. 166.—OPOSSUM SHRIMP.

THIRD ORDER OF CRUSTACEANS.

AMPHIPODA.*

In the succeeding Crustaceans the eyes are sessile, that is, not supported on jointed stems, and consequently motionless. The legs appended to the different segments vary much in their structure. The Amphipods have their limbs arranged in two groups opposed to each other. Their body is generally compressed and curved towards the breast; they swim and leap with facility, but always lying on one side. Some of them inhabit fresh water, but by far the greater number are marine.

* *αμφι*, amphi, *of two sorts*; *πους*, pous, *a foot*.

The importance of these Crustaceans in the economy of Nature is very great—making up for the smallness of their size by the immense numbers in which they exist, and the ubiquity of their presence. They are ready at the first moment to seize upon the dead matter that constitutes their ordinary food, and thus to act their part as scavengers of the ocean without the least delay, whilst in their turn they furnish an abundance of excellent nourishment to fishes and other aquatic animals. To this order belong—

The **Sand-hoppers*** (*Gammarus*). These animals may be seen in abundance by the seaside in summer-time, where they carry on a continual warfare against the annelidans of all sorts, found on the shore. Nothing is more curious than to see them, when the tide is coming in, congregated in myriads, beating the sand in all directions in search of their victims. No sooner do they meet with one of their favourite worms, than they attack it, and although it may be ten times their own size, soon kill and devour it. They never leave off this work of butchery till they have fairly gone over all the mud upon the shore. They are equally ready to attack mollusca, fishes, or even human bodies cast up upon the beach. In their turn, they supply an abundant stock of food to multitudes of shore-birds and fishes.

Dr. Sutherland relates that in Davis Straits he has seen an entire seal reduced to a perfect skeleton in less than two days, by *Gammarus articus.*

It is a species of *Sand-hopper* (*Talitrus*) that is alluded to by Archdeacon Paley, as exemplifying the abundance of happiness bestowed on the lower animals. "Walking by the seaside in a calm evening upon a sandy shore, with an ebbing tide, I have frequently remarked the appearance of a dark cloud, or rather very thick mist, hanging over the edge of the water, to the height, perhaps, of half a yard, and of the breadth of two or three yards, stretching along the coast as far as the eye could reach, and always retiring with the water. When this cloud came to be examined, it proved to be nothing else than so much space filled with young shrimps, in the act of bounding into the air from the shallow margin of the water, or from the wet sand. If any motion of a mute animal could express delight, it was this; if they

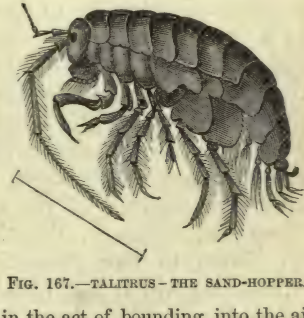

FIG. 167.—TALITRUS – THE SAND-HOPPER.

* κάμμαρος, kammaros, *a kind of crab or shrimp.*

could have made signs of their happiness, they could not have done it more intelligibly."

In order to leap, they bend the appendages to their tail under their body, and then forcibly straighten them as though they were let go by a spring, exactly like the Poduræ or Spring-tails among insects.

Fourth Order of Crustacea.

Læmodipoda‡ (*Neck-footed Crustaceans*).

The body of these creatures is generally slender and elongated, and composed of eight or nine seg-

Fig. 168.—Caprella.

ments. The four front legs, which are always the largest, are attached to the neck, and are terminated by a prehensile hook. The hinder legs are shorter, and their armature more feeble. The females carry their eggs between the second and third segments of the body, in a little pouch formed of scaly pieces. The species are all marine. Some of them live amongst sea weeds, upon which they crawl, much after the manner of the caterpillars called loopers. They are, however, likewise able to swim. Others are found to live parasitically upon whales, a circumstance which has obtained for them the name of whale-lice. They have likewise been seen on the mackerel.

* λαιμός, laimos, *the throat*; δίς, dis, *twice*; πόυς-ποδός, pous-podos, *a foot*.

Fifth Order of Crustacea.

Isopoda* (*Similar-legged Crustaceans*)

Differ from the preceding in many important particulars. The two anterior feet are never annexed to the head, but are appended to a distinct segment, and furnished with simple pointed claws. In some species which are terrestrial in their habits, two of the antennæ (the middle pair) are almost obliterated. The females carry their eggs attached to the under part of their body, either enclosed by scaly plates, or lodged in a membranous pouch. The young are born in every respect resembling their parents, and only change their skin as they increase their size. The greater number live in the water, and those which reside on the land, require a certain degree of dampness to enable them to respire.

We select as examples of this order the redoubtable

Boring Shrimps (*Limnoria terebrans*), so called from its habit of boring into wood submerged beneath the surface of the sea. Although this little creature is not more than two lines in length, it is, from its habits and its rapid multiplication, very destructive. It pierces the planks of ships in every direction with alarming rapidity, and in seaports and dockyards its ravages are very serious. When seized, it rolls itself up into a ball.

Fig. 169.—Limnoria terebrans.

The *Chelura terebrans* is another timber-destroyer, equally redoubtable. It excavates the wood, not merely for the purpose of concealment, but with the object of employing it as food. It will freely attach itself to a piece of wood placed with it in a glass of water, so that its habits may be studied in confinement. Timber which has been subjected to the ravages of *Chelura* presents a somewhat different appearance from that which has been attacked by *Limnoria terebrans*. In the latter we find deep, cylindrical grooves, running deep into the interior, while the excavations of *Chelura* are considerably larger and more oblique in their direction, so that the surface of the timber thus undermined by these animals is rapidly washed away by the action of the sea, and the excavations are exposed in the greater part of their

* ἴσος, isos, *equal ;* πόυς, pous, *a foot.*

extent, the wood appearing ploughed up, so to speak, rather than burrowed into. Upon the whole, *Chelura* would seem to be a more destructive creature than even *Limnoria.*

The **Fresh-water Shrimp** (*Asellus*) is met with abundantly in our ponds and streams. It walks with difficulty, but swims rapidly, lying on its side. The eggs of the female are carried in a bag attached beneath the body. They are very voracious, and as they eagerly devour all dead animal substances, are beneficial agents in purifying the water.

The **Wood Lice** (*Oniscus*) are terrestrial in their habits. They are to be met with everywhere in dark and damp situations, such as caverns, cellars, in holes in old walls, under stones or beams of wood, window-sashes, and similar localities. They feed entirely upon decayed animal and vegetable substances, and never leave their retreat, except in rainy or damp weather.

ENTOMOSTRACA.*

SIXTH ORDER OF CRUSTACEA.

BRANCHIOPODA† (*Gill-footed Crustaceans*).

Any one who has ever examined a phial of water taken from any ditch, must have observed in it a variety of tiny, but most indefatigable, little creatures, that move actively by short jerks, or dart to and fro with a rapidity that the eye can scarcely follow; the jerking ones (Fig. 170, 3) are species of Daphnia; the more fleet, darting forms are of the genus Cyclops (Fig. 170, 1); and another tribe, still more varied in shape, that keep chiefly near the bottom, and creep nimbly, more than they swim, are the Cyprides (Fig. 170, 2): all these, under a microscope, are exceedingly beautiful. Some have their bodies enclosed between two delicate plates, united above the back, and resembling a bivalve shell; this shell is usually more or less transparent, and delicately tesselated, or marked with an intricate network of raised lines. The antennæ are often curiously branched, and appear to be used as oars. It is a re-

* ἔντομος, entomos, *an insect;* ὄστρακον, ostrakon, *a shell—i. e.*, insects with shells.

† βράγχια, branchia, *gills;* πούς-ποδός, pous-podos, *a foot*—so called because their feet perform the functions of gills.

markable character of all these pretty little "water-fleas" that they seem to have but a single eye, which is generally of a bright crimson hue, sparkling like a little ruby, and set in the front of the head.

FIG. 170.—WATER-FLEAS: 1. *Cyclops communis*; 2. *Cypris unifasciata*; 3. *Daphnia pulex.*

Some of these **Entomostraca**, as they are called (that is, insects with shells), inhabit the sea, and may be met with in abundance in clear pools worn in the

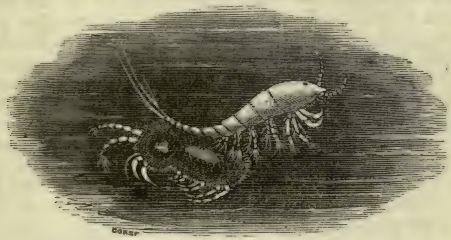

FIG. 171.—MARINE ENTOMOSTRACA (*Cythere albo-maculata* and *Cyclops chelifer*).

rocks, sporting about amongst the confervæ and corallines that often so fancifully fringe their edges and decorate their sides, forming a miniature subaqueous forest, for myriads of living creatures to

disport themselves in. Two examples of these marine forms are represented in the accompanying figure (Fig. 171).

The Branchiopod Entomostracans are divided into two sections,—1st, those with tufted feet (Lophyropes)*; and 2ndly, those with laminated feet (Phyllopes).†

The **Tufted-feet Entomostracans** (*Lophyropes*), are distinguishable by the number of their feet, which never exceed ten; their legs, moreover, are cylindrical, and never flattened out into leaf-like expansions. To this division belong

The **Cyclops** (*Cyclops*), so called on account of their having apparently but one eye.‡

The **Common Cyclops** (*Cyclops Vulgaris*), (Fig. 170, 1), remarkable for the metamorphoses it undergoes, is common in fresh water. On each side of the tail of the female is a pellucid oval sac, filled with eggs, with which it is replenished eight or ten times in the course of three months; and as the female begins to lay at an early age, supposing the average number of eggs to be forty each time, the multitude of which a single individual may become the progenitor, during six months, is enormous. The young at their birth have only four feet, and their body is rounded and tail-less: in due time other limbs appear, and after a few moults the tail is developed. These little creatures are capable of resisting cold in a remarkable manner. They have been repeatedly seen frozen up in ice, which, on melting, was full of them, as active as ever. They will also endure being dried, but not for many minutes. Jurine found that out of twelve individuals dried for fifteen minutes, five only recovered on being restored to the water; and that of twelve kept dry for twenty-five minutes, all perished. Yet, as in seasons of drought the ponds and ditches are dried, it is most probable that they will retain life buried in the mud as long as any moisture remains. The eggs, however, according to Strauss, do not perish, even should the parents, but become hatched in the course of four or five days, when the ponds are replenished. As these little creatures grow, they change their shells or transparent horny investment, like other crustaceans. The change of shells is very complete; not only the general investment of the body is thrown off, but also the outer layer of the fine branchiæ and the minutest hairs on the antennæ. The size of the adult Cyclops is about the one-sixteenth of an inch.

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* λόφουρος, lophouros, *tail furnished with long hairs;* πούς, pous, *a foot.*

† φύλλον, phyllon, *a leaf;* πούς, pous, *a foot.*

‡ κύκλωψ, cyclops, literally, "*round-eyed;*" so called after the fabled giants, said to have but one eye in the middle of their forehead.

The **Cythereas** (*Cythere*), (Fig. 171), are marine; they live among the fuci and confervæ found in little pools among the shingle on the sea-shore, and the naturalist may specially find them in abundance in those beautiful clear little round wells, hollowed out of the rocks which are within reach of the renovating influence of the tide. In such delightful pools, sheltered among the "umbrageous multitudes" of stems and branches, and nestling in security, weak and powerless as such pigmies seem to be, they are found as numerous and active after the shores have been desolated by the power of a fierce tempest, as when the waves have rolled gently and calmly to the shore with their sweetest murmurs.

The **Cyprides** (*Cypris*), (Fig. 170, 2) have only six legs, and their two antennæ are furnished with a tuft of hair apiece; their body is enclosed in an oval shell compressed at the sides. These little creatures swim with considerable rapidity, apparently by means of their antennæ; they are likewise able to crawl with their little hooked feet upon the surface of the submerged plants. The female lays her eggs in masses upon the stems of vegetables or on the mud, sometimes as many as eighty at a birth, and, strange to say, the females hatched from these eggs, although kept quite apart, are equally prolific with the rest.

The **Daphniæ** (*Daphniæ*), (Fig. 170, 3) are likewise enclosed in a shelly covering, and swim actively by means of their tufted antennæ. Their fecundity is prodigious; and the female will lay many successive generations of eggs in the course of the summer, all of which give birth to equally fertile females. It has been calculated that the progeny of a single individual may amount even during her lifetime to four billions and a half, the aggregate of which would weigh nearly eight tons.

The second section of the Branchiopod Entomostracans, that of

The **Phyllopeds** (*Phyllopa*), includes those genera whose legs, at least twenty in number, are composed of flattened and leaf-like laminæ. Their eyes are always two in number, and sometimes pedunculated.

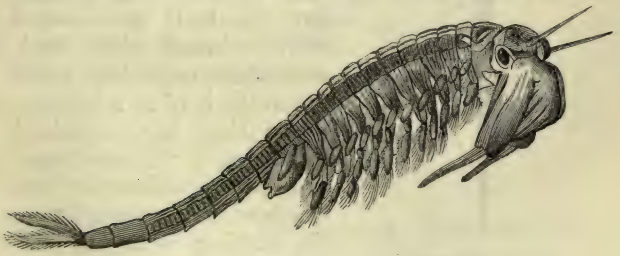


Fig. 172—FAIRY SHRIMP.

To this section belong

The **Fairy Shrimps** (*Chirocephalus diaphanus*), (Fig. 172), occasionally met with in ponds. These pretty creatures, which are as trans-

parent as glass, swim or rather glide through the water with their backs downwards, whilst the undulating play of their numerous legs causes currents that bring nutritive particles towards their mouth in a continuous stream.

The **Salt-water Shrimps** (*Artemia salina*) are met with in the salt-pans at Lymington, where they live in a brine sufficiently strong to pickle a round of beef.

The Seventh Order of Crustaceans.

Sword-tails (*Xiphosuri*).*

This order contains but a single genus, namely

The **King-Crabs** (*Limulus*), a most extraordinary race of creatures, commonly met with on the shores of tropical climates, both of the old and new world. In these animals the tail is consolidated into a single piece, forming a long, pointed, and extremely hard spine furnished with jagged edges, and a point so sharp, that in the hands of savages, it forms a weapon of most formidable character. The King-Crab has no distinct head, but its body is covered with a broad, thin shell, somewhat resembling in its shape the hoof of a horse—hence they have obtained the name of "Horse-foots" from the inhabitants of the coasts where they are found. On turning over this singular creature we find that it possesses six pairs of well-formed feet, the thighs or basal joints of which, armed with teeth and spines,

Fig. 173.—king-crab.

* ξίφος, xiphos, *a sword* ; ὀυρά, oura, *a tail.*

serve the extraordinary purpose of jaws, being used to masticate the food and force it into the mouth which is situated between them. Behind these are several other pairs of legs of very different structure; they are leaf-like and perform the office of gills, each carrying on its outer edge a series of thin plates somewhat resembling the leaves of a book, and thus affording a considerable respiratory surface. The first pair of these gill-feet are very large, and overlap all the others so as to protect and conceal them. The King-Crabs frequently come ashore, traversing the flat sandy beaches, and look like self-moving shields, none of the limbs being visible. They endure with difficulty the heat of the sun, and when stranded, often bury themselves for shelter. Their food consists of animal substances. Some are of very large size, occasionally measuring upwards of two feet in length. The savages of the Moluccas are in the habit of employing the caudal spikes as heads for their spears and points for their arrows. These animals are so common on the coasts of the West Indies and of the American Continent, south of New York, that, being slow in their movements and easily capsized by the waves, their dead bodies sometimes cover the shore to such an extent that a person might walk on them for ten miles without ever touching the ground. The hogs are regularly driven to the beach to feed on them, and their bodies are carted into the country to be used as manure. In China their eggs are used as an article of food.

Eighth Order.

Sucking-mouthed Crustaceans (*Siphonostomata*).*

The **Suctorial Crustaceans** have the mouth adapted for sucking the juices that they obtain from the bodies of other animals; they are, therefore, essentially

* *σιφων*, siphon, *a sucking-pipe*; *στόμα*, stoma, *a mouth*.

parasitic. They are met with adherent to the skins and eyes of fishes, or sometimes to their gills and the interior of their mouths. Their forms are extremely variable, and all appear to undergo several transformations in their progress from birth to maturity; this group embraces

The **Pycnogons**,* strange-looking creatures, of small size, with very long limbs, and their body divided into segments. They mostly

FIG. 174.—PYCNOGON.

take up their abode under stones along the coast, or are found crawling upon seaweed, or sometimes they hook themselves on to fishes and other marine animals.

The **Fish Lice**, among which may be mentioned the *Caligus Mülleri*, found adhering to the gill-covers of the cod-fish, to which it holds on by claws that terminate its fore-limbs, while with its beak it sucks the food upon which it lives. All of these animals are parasitic, and are found attached to the gills or other parts of fishes by means of a formidable apparatus of hooks and suckers; some species seem permanently fixed to their victims, but others are able to relax their hold at will and change their place.

FIG. 175.—LERNEAN.

The **Lerneans** constitute a very extensive group, remarkable for the singularity of their appearance. When young they resemble the young of cyclops, and are then provided with a frontal eye and natatory limbs, swimming with facility; but having undergone a certain number of moults, they cease to lead an erratic life. The limbs now, no longer needed, become lost or waste away. The eye generally disappears and the body assumes a strange form. The female is at this time found fixed to some fish or other aquatic animal by means of curious appendages resembling distorted limbs or moveable claws. As an example, we mention the *Lernæa monilaris*, which attaches itself to

* πυκνός, pycnos, *thick*; γόνυ, gony, *the knee*.

the eye of the sprat, plunging its whole head into the coats of that organ, where it is retained by means of barbed projections. It is luminous in the dark, and the fishermen are accustomed to call the unfortunate fishes thus infested *lantern sprats.*

Ninth Order of Crustaceans.

Wheel-bearers (*Rotifera*).*

Our stagnant waters everywhere abound with innumerable tribes of microscopic animalcules, some of which have been described in an early chapter. Returning to this spectacle, suppose we take from any pool a leaf of duck-weed, with a few drops adhering to it, and, placing this beneath our microscope, carefully inspect the little world exhibited within. The crowds of *Infusoria* are recognized at once, as they go gliding past, or sporting in mazy dance, but ever and anon there comes rushing among their swarms, like a fierce tiger through a flock of sheep, some monster of a different kind, having on its head what appear to be great wheels, that spin continually round and round, and, like the paddles of a steamboat, serve to move it through the water. The animals in question have been named *Rotifera* or "Wheel-bearers." In their size they much exceed the humbler Infusoria, over which they tyrannize. Their length may be roughly estimated at about one-fiftieth to one-hundredth of an inch—terrific giants when compared with the small fry around them, although themselves scarcely perceptible by unassisted vision.

The distinguishing character from which these minute but highly-organized beings have derived their name, is the remarkable appearance of their so-called wheels. This exactly resembles the movement of the crown-wheel of a watch in swift rotation, and the early microscopic observers supposed such to be actually the kind of movement with which the organs in question were endowed, though by what kind of mechanism living wheels could really

† Rota, *a wheel;* fero, *I carry.*

spin round, and yet preserve their connexion with the animal, they could not conceive. Better instruments, however, and closer observation, have solved the difficulty. Instead of being real revolutions of wheels, it is now clearly established that the apparent rotations are merely an optical illusion, similar to that by which, when the tide is rolling in

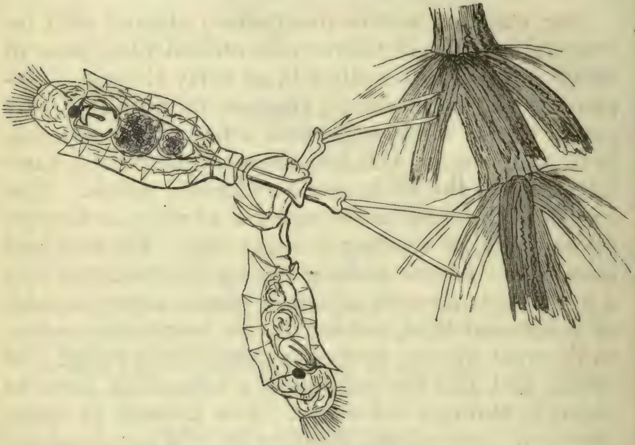


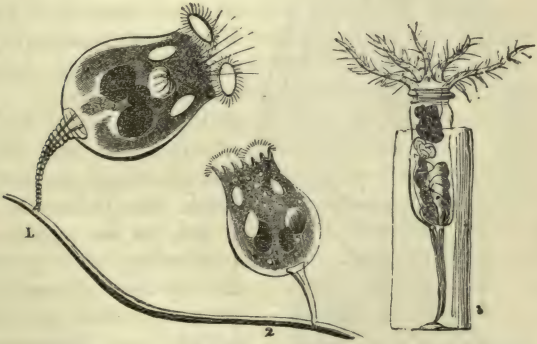
FIG. 176.—SKELETON WHEEL BEARER.

upon the beach, the waves appear to the eye to move rapidly forward, while, as is well known, they merely rise and fall in constant succession. The true explanation of the once mysterious phenomenon is as follows:—Examined under high powers, the cilia have the appearance of moving in waves, in the production of which from a dozen to twenty cilia are concerned, the highest point of each wave being formed by a cilium extended to its full length, while the lowest point between every two waves is occupied by one folded down upon itself, the intervening space being filled by others in every intermediate degree of extension. As the continuance of each cilium in any one of these positions is of the shortest possible duration, and each takes up in regular suc-

cession the action of the adjoining one, that cilium which, by being completely folded up, formed the lowest point between any two waves, in its turn, by its complete extension forms the highest point of the next wave, and thus, while the cilia are alternately bending and unbending themselves, the *waves* appear to travel onward, while the cilia never change their position.

The ciliary apparatus is evidently under the control of the animal. The whole fringe of cilia may be instantly set in motion, and as instantly stopped, or their action regulated to any degree of rapidity.

A very slight examination of these minute creatures with the microscope, will show that the ciliary movement answers a double purpose. If the little Rotifer attaches itself to some fixed object, by means of its forcipated tail, as represented in the figure (Fig. 177), the cilia, by producing currents in the water, all converging towards the mouth, insure an abundant supply of food, by hurrying down the gaping throat whatever minute aliment may be



1, 2, *Brachionus*. FIG. 177.—ROTIFERA. 3, *Stephanoceros*.

brought within range of the vortex thus caused; or, on the other hand, if the animal disengages itself from the substance to which it is held by its curious anchor, the wheels acting upon the principle of

paddle-wheels, carry it rapidly along with an equable gliding movement.

Some of these little creatures are enclosed in a transparent shell, often variously armed with spines at one or both extremities, but others are not so enclosed.

The eggs of the Rotifera form beautiful objects for microscopic study. They are covered with a transparent shell, through which the parts of the embryo, as they develop themselves, gradually become distinctly apparent, until at length the cilia are seen performing their mimic rotation, though as yet the imprisoning shell has not been broken. At last, by the action of these organs, which every moment becomes more energetic, the transparent membrane is ruptured, and the little creature bursts forth, eager to enter upon its new existence, and already possessing the form of its parent. The time from the exclusion of the egg to the hatching is commonly about twelve hours. Ehrenberg watched an individual through eighteen successive days; it was full grown when he first observed it, and it did not die of old age at last. Such an individual he found to be capable of producing four eggs every twenty-four hours, the progeny derived from which grow to maturity and exclude their fertile ova in the same period, a single Rotifer thus producing in ten days forty eggs, developed with the rapidity thus stated; this

FIG. 178.—BRACHIONUS.

rate, raised to the tenth power, gives one million of individuals derived from one parent, on the eleventh day four millions, on the twelfth day sixteen millions, and so on. Well may our ponds and ditches swarm with their multitudes, and countless creatures dependent on such a supply, rejoice at the abundance of food thus supplied to them.

But the Rotifera are not only thus numerous in large collections of fresh water; they are met with in cart-ruts, in gutters, in rain-spouts, and in the depressions and corners of leads on the roofs of houses. The fact that the water in these situations is frequently dried up, does not at all prevent their presence. The sand in such places sometimes contains millions of them, dried to dust of a reddish brown hue; and if a little of this dust be put into clear water, they will in a short time revive, and swim about as actively as if they had never been dried. One species, the *Rotifer redivivus*, has derived its name from this circumstance. Specimens have been kept in a dry state for four years, and then resuscitated on being moistened. From this fact it becomes easy to explain how collections of water, however free from such inhabitants at first, become filled to swarming with Infusory and Rotiferous forms of life. When the once thickly-tenanted pool, says Professor Owen, is dried up, the inconceivably minute ova, and equally imperceptible dried bodies of these creatures, will be raised as dust by the first puff of wind, and diffused through the atmosphere; there they may long remain suspended, forming, perhaps, their share of the particles which we see flickering in the sunbeam, ready to fall into any collection of water, beaten down by every summer shower and, by virtue of their tenacity of vitality, ready to start to life wherever they may find the requisite conditions for their existence.

It is almost impossible to conceive of the outburst of fresh life caused by the return of moisture in tropical climates. Immediately prior to the

setting in of the annual rains, the swamps, pools, water-courses, and even the majestic rivers themselves, are well near dried up. The surface of the soil is parched into a layer of impalpable dust, and the remnants of all the minute tribes of plants are carried to and fro by the slightest winds, amongst the dusty particles to which they themselves largely contribute. In them vitality is maintained under the minimum of the conditions essential to its continuance, and without the interposition of this phase of their existence, these organisms would soon become extinct. For upwards of two months the rains continue to fall incessantly. The whole country is flooded, and the rivers expand to the proportions of inland seas. But no sooner have the rains and inundations subsided, than the mud-laden pools clear down, the magic influences of light and heat are permitted to operate, and in an inconceivably brief period, the surface, the bottom, and the body of the waters absolutely teem with the crowded masses of animal and of vegetable life, amidst which the wheel-animalcules revel in all the luxury of abundance.

TENTH ORDER OF CRUSTACEANS.

CIRRIPEDIA* (*Barnacles*).

Every visitor to the sea-shore has doubtless observed the rocks and stones, the timbers of the jetties, or any objects that have been long immersed in the sea, thickly encrusted with shells of remarkable construction, usually known by the name of *Barnacles* or *Acorn-shells.* On placing a stone or shell thus encrusted (taken fresh from the sea, so that the animals may be in full life and vigour) in a glass of clear sea-water, and watching them attentively, the acorn-shells upon its surface will be seen to open, and presently a beautiful feather-

* Cirrus, *a lock of hair*; pes, *a foot.*

like apparatus will be protruded, and again withdrawn. After a few seconds this movement will be repeated, and again and again the feathery structures will be put forth, and retracted with such grace, regularity, and precision, that they present an appearance exquisitely beautiful. These are the arms or *Cirri* of the contained animal. When fully expanded, it will be seen that their plumose and flexible stems form a most wonderful prehensile apparatus, admirably adapted to entangle any nutritious particles or minute living creatures that may happen to be present in the circumscribed space over which this singular casting-net is thrown, and drag them down into the vicinity of the mouth, where, being seized by the jaws, they are crushed and appropriated as food. No sense but that of touch is required for the success of this singular mode of fishing, and the delicacy with which the arms perceive the slightest contact of foreign bodies, shows that they are eminently sensitive.

FIG. 179.—CIRRI OF BARNACLE.

It is from these remarkably-constructed limbs or *Cirri* that the Order derives its name. Although in their adult state the Cirripedes are fixed and stationary, and enclosed in dense and strong shells, the newly-hatched young present a very different shape, and, strange to say, are furnished with limbs calculated to enable them to swim freely about, under the appearance of Entomostracous Crustaceans; and it is only after undergoing several changes of form, that they lose their wandering habits. The young Cirripedes, on emerging from the eggs, are very different in structure from their parents. They possess loco-

motive organs consisting of a large pair of limbs provided with a sucker and hooks, adapted for mooring themselves at pleasure to any foreign object; and also of six pairs of swimming-legs, that act in concert like oars. Besides these, they have a tail bent under their body, consisting of two joints, and terminated by four bristles, which constitutes an additional apparatus of propulsion. Thus endowed, they swim along in a series of bounds, the oars and

Fig. 180.—Young of barnacle.

tail giving, in measured time, successive impulses. They have, moreover, large lateral eyes, and the body is covered with a sort of shell, such as we see in the early state of certain Entomostracans (Cyclops), which they closely resemble. Believing little creatures so constructed to be the larvæ of some Crustaceans, they were kept by Mr. J. V. Thompson in a glass vessel, covered to such a depth with sea-water, that they could be examined at any time by means of a common magnifying-glass, and, to his great surprise, in the course of a few days they threw off their larva skins, and became firmly adherent to the bottom of the vessel, changed into young Barnacles, such as are usually seen in the spring-time intermixed with

grown specimens on rocks and stones. In this stage the valves of the shell and of the operculum were visible, as well as the movements of the arms of the contained animal, although these last were not yet completely developed. The eyes, also, were still perceptible, but these gradually disappear with the increasing opacity of the shell; and the animal becomes blind for the remainder of its life. Thus, then, a creature originally free, capable of swimming about, and furnished with distinct organs of sight, becomes permanently and immoveably fixed, and its optical apparatus obliterated.

The Cirripedes are divided into two families.

The **Barnacles** (*Lepas*), (Fig. 181) are always found attached to some foreign substance by a long flexible peduncle, which pos-

FIG. 181.—BARNACLES.

sesses great power of contraction. Each valve of their shell is usually composed of two triangular pieces, and is closed at the back by an elongated plate, so that the whole shell consists of five pieces. They are very widely disseminated, and adhere to submarine

bodies in considerable numbers. They are found, not only on floating wood, the hulls of ships, bottles, and other articles floating about, but on shells, on turtles, whales, and even sea-snakes. Large logs of timber are sometimes completely covered with them, compacted in close array, writhing and twisting about, like the serpents on Medusa's head, and presenting a most remarkable spectacle.

The **Acorn-shells** (*Balani*), (Fig. 182), in their general structure and habits resemble the Barnacles; they have, however, no pedicle

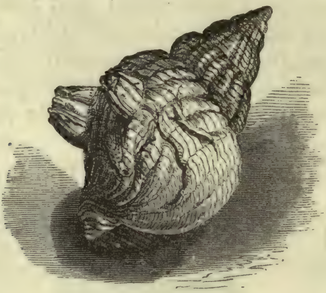


FIG. 182.—ACORN-SHELLS ON THE SHELL OF A WHELK.

or foot-stalk, but are sessile—that is, are fixed immediately to the substances upon which they attach themselves, or in which they are more or less imbedded. The common species is often found in great numbers, covering the shells of mussels and oysters, and may thus be easily procured for examination. Taking one of these as an example of the group, we find them to consist of a shelly cone composed of various pieces, accurately fitted together, and capable of enlarging with the growth of the animal. A thin calcareous base or closing plate, fixes the cone to the substance on which it rests, while its apex presents four pieces, that form an operculum or valvular lid, so disposed as to shut up the aperture when the animal retires into its shell; but easily opened for the protrusion of the cirri. The Acorn-shells are widely spread; groups of different species are found covering rocks, floating wood, shells of various kinds, or even the backs of crabs and lobsters; any objects, in short, which will afford them a secure resting-place.

MOLLUSCA.

Widely different in their appearance from the Articulata described in the last chapters are the creatures that next present themselves. Instead of possessing an external skeleton, divided into numerous segments and furnished with jointed limbs, the *Mollusca* are either entirely naked and defenceless, or else have their bodies protected by shells, in

which they frequently reside, and hence are generally known by the name of "Shell-fish." Formerly the animals which formed and inhabited these shells were little known, and, consequently, little attended to. The shells alone attracted the attention of the student, and hence the study of this branch of natural science received the name of Conchology,* and the appellation is still in general use. At the present day, however, the animals receive an equal share of attention from the naturalist; and the arrangement of their hard persistent coverings depends almost entirely upon the structure of the animals which formed them.

Mollusks may be defined as soft and fleshy animals, devoid of bones or any internal skeleton, and not divided, like Insects and Worms, into rings or articulations. Their body is covered with an irritable and contractile skin, which is moistened by a viscid liquor that exudes from it, and which is in very many instances ample enough to form folds that envelope the creature more or less completely as in a mantle or cloak. In some cases this skin is naked, and then the mantle is thick and viscous: in the greater number, however, it is protected by a hard covering, called a *shell,* beneath which the mantle is thin and transparent. Their most essential character, however, lies in their nervous system, which consists of a certain number of nervous centres or *ganglia,* from which the nerves are given off to different parts of the body. These ganglia are principally concentrated around the entrance to the alimentary canal, and form a collar, or ring, that surrounds the œsophagus, or throat, and is connected with other ganglia, *disposed without symmetry among the viscera, or in the neighbourhood of the organs of locomotion.* From this unsymmetrical condition of the nervous centres, the whole class has received the name of **Heterogangliata.**† Many of the Mollusca

* *κόνχη*, conche, *a shell*; *λόγος*, logos, *a discourse.*

† *ἕτερος*, heteros, *dissimilar* ¬ *άνγλιον*, ganglion, *a ganglion.*

are terrestrial, and breathe the air; but the greater part live entirely in the water, from which they derive their nutriment, and in which they breathe by the aid of branchiæ, or gill-like appendages. Those which are terrestrial are seen in our gardens, pastures, and plantations; on the trunks and stems of trees, and in moist and shady places; while multitudes of the aquatic species are to be found in the seas both of tropical and arctic regions, as well as in those which environ our own islands. Others dwell in lakes and ponds of fresh water, or live at the bottom of rapid streams: some are amphibious. In short, they may be said to be universally distributed wherever circumstances permit of their existence.

The number of species already in museums probably reaches 8,000 or 10,000. There are cabinets of marine shells, bivalve and univalve, which contain from 5,000 or 6,000, and collections of land and fluviatile shells which count as many as 2,000. The total number of Mollusks, therefore, probably exceeds 15,000 species. The Mollusca can only be studied properly in a living state; it is only then that they develop their form and true appearance by unfolding their different organs, which in the dead animal are always shrunk, retracted, collapsed, or disfigured to such an extent that there is no possibility of delineating them, insomuch, indeed, that the same individual has again and again been described under various names, as belonging to different species.

When we call to mind the incalculable numbers of these creatures that crawl on the bottom or swim in the bosom of the ocean, and that everywhere abound on dry land, it is evident that their importance in creation must be great, beyond human speculation. They are the frequent victims of the indiscriminating and almost insatiable appetite of fishes, and from the stomach of a cod or a flounder you may procure many a shell, not otherwise so easily obtainable. They constitute the principal food of innumerable birds and reptiles. They

furnish materials valuable in the arts, and many of them are eaten by mankind.

Various are the forms, and widely different the relative perfection of the Mollusca as regards their endowments and capabilities; some, as the **Polyzoa**, fixed to the surface of foreign bodies, entirely deprived of organs connected with the higher senses, and unable to change their position, are content to protrude at intervals their ciliated arms, and thus entrap such passing prey as suits their appetite. Others equally incapable of locomotion, but furnished with arms of different construction (**Brachiopoda**), catch their food by an equally curious mechanism. The **Tunicata** enclosed in leather-like bags, firmly rooted to the rocks, or aggregated into singular compound masses, adorn the beach with their kaleidoscope patterns, or float through the ocean at the mercy of the waves. The **Conchifera** inhabit bivalve shells; while the **Gasteropod** orders, likewise defended in most instances by a shelly covering, creep about by means of a fleshy disk, and thus being endowed with a locomotive apparatus, exhibit senses of proportionate perfection. The **Pteropoda** swim in myriads through the sea, supported by two fleshy fins; while the **Cephalopoda**, the most highly organized of this large division of animated nature, furnished with both eyes and ears, and armed with formidable means of destroying prey, become tyrants of the deep, and gradually conduct us to the most exalted type of animal existence. These different sections, which constitute so many distinct classes, into which the Mollusca have been divided by zoologists, may be arranged in accordance with the following tabular view:—

TABULAR VIEW OF THE MOLLUSCA.

MOLLUSCA.	Having a distinct head and a body . . .	In the form of a sack open in front from which the head, furnished with fleshy arms, projects		CEPHALOPODA.
		Not in the form of a sack open in front, and the head not surmounted with fleshy arms . . . . . . The principal organ of motion being	Membranous fins in the form of wings on the sides of the neck . . .	PTEROPODA.
			A fleshy foot occupying the ventral surface of the body	GASTEROPODA.
	Having no apparent head . .	Having four branchiæ distinct from the mantle, and almost always a fleshy foot		CONCHIFERA.
		Having no fleshy foot	Provided with two ciliated arms . .	BRACHIOPODA.
			Unprovided with arms or special organs of motion	TUNICATA.
			Form polype-like, mouth surrounded by ciliated tentacula	POLYZOA.

CHAPTER XIV.

First Class of Mollusca.

Polyzoa.*

Those who have amused themselves with collecting seaweeds upon the shore, may have often observed their stems to be covered in patches with a delicate film so thin as not to hide the form of the surface on which it is spread, yet when closely examined with a magnifying-glass, discovered to consist of a vast number of symmetrical cells, placed close to each other, somewhat like those of a honeycomb. Or the inquisitive collector may have found a substance very similar to the above in its texture and appearance, but floating loosely in the water, and itself taking the form of a branched and leaf-like seaweed, presenting on both sides of its flattened expansion the same honeycomb arrangement of tiny cells.

Such are the **Sea-Mats** (*Flustra*) (Fig. 183). If we

Fig. 183.—Flustra foliacea.

* πολύς, polys, *many*; ζῶα, zoa, *animals*, so called because they are generally associated in considerable numbers.

take a portion of one of these very common productions, and bring it under a lens of high magnifying power, its entire surface is found to be made up on both sides by an assemblage of cells of a somewhat horny texture, the margins of which are beset with spines arranged with great regularity. Should the specimen happen to be alive, it will be seen, on placing it in a glass of sea-water, that every cell is inhabited by a little hungry, active animal, polype-

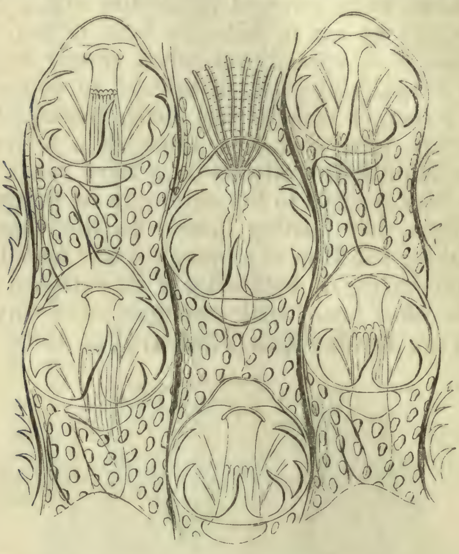


FIG. 184.—CELLS OF FLUSTRA MAGNIFIED.

like in its form, but displaying a much more complicated structure. Around its mouth are set numerous long tentacles; but these are not mere smooth filaments, or petal-like appendages, like those of the true polypes, described in a former chapter, but they are furnished with innumerable cilia arranged in rows, which being set in rapid vibration at the will of the animal, produce strong and constant currents in the surrounding water, all of which con-

verge towards the central mouth. By this wonderful provision two ends are obtained; the particles of water are incessantly renewed for the purpose of respiration, and by the same means every minute substance, animal or vegetable, that happens to be swimming in the neighbourhood, is dragged by the ceaseless whirlpool into the midst of the ciliated tentacles, and thus brought to the mouth, where such as are fit for prey are seized and swallowed.

On the very Flustra we have been describing, there often exists an example of a parasitic production, belonging to the same class, the structure of which is still more marvellous.

The **Sea Moss** (*Bowerbankia densa*) forms beneath the microscope an object of matchless beauty. This little parasitic Polyzoon (Fig. 185) consists of innumerable polype-like creatures, each inhabiting an extremely delicate transparent tube; clusters of these glassy cells arise from a creeping stem, common

FIG. 185.—BOWERBANKIA.

to the whole group. Examined with a microscope, the tubes in which these minute animals live are

found to consist of three portions. The lower part is stiff and horny, though quite pellucid; towards its upper third, however, it becomes flexible, and at length terminates in a marginal row of delicate horny filaments, united by a web or membrane of exquisite tenuity. Above these filaments the ciliated tentacles expand, and form a sort of funnel, of which the mouth is the apex or centre. Though the tentacles are commonly stiff and motionless when expanded, they are highly sensitive, and on the least alarm are drawn within the tube, the mouth of which is then closed by the beautiful mechanism above described, the horny filaments that surround it closing over them, as represented in the engraving.

Many species of these marine Polyzoa are furnished with numerous organs appended to the exterior of the cells, which are of a most remarkable and inexplicable character. These organs are called *Avicularia,** and resemble vultures' heads; not a cell is without its bird's head, and all are employed in see-sawing, snapping, and opening their jaws with the most amusing activity. Nay, strange to say, even in specimens, the animals of which are all dead, these "birds' heads" are sometimes equally active. If we take a Polyzoon of this description, and drop it, while in full activity, into a narrow glass cell, with parallel sides, filled with the purest sea-water, and here examine it with the microscope, the Polype-like creatures protruding their crystal stars of tentacles, the birds' heads nodding to and fro their bald pates, and opening and shutting their frightfully gaping jaws like snapping turtles, form altogether a scene quite indescribable.

More than one observer has noticed the seizure of small roving animals by the pincer-like beaks of the Aviculariæ; and hence the conclusion is pretty general that they are in some way connected with the procuration of food; seeing, however, that these organs have no power of passing the prey thus

* Avicula, *a little bird.*

seized to the mouth of the Polyzoon, and, also, that this latter is situated at the bottom of a funnel of

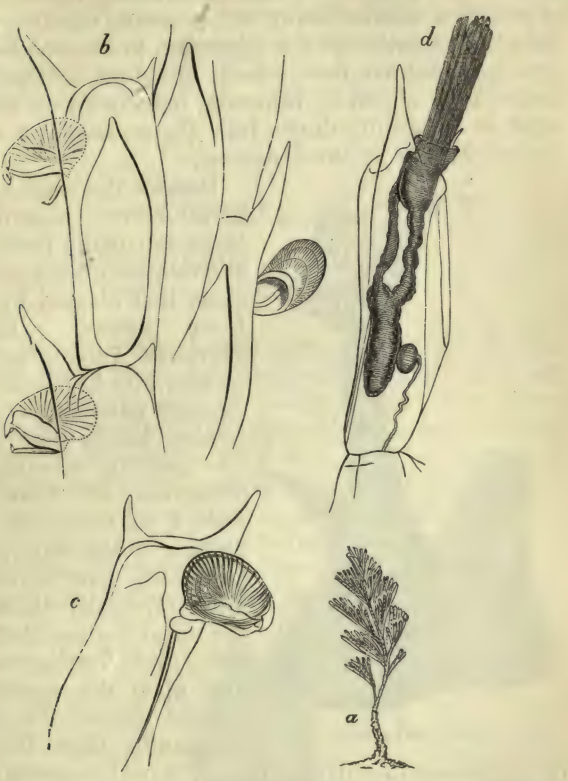


FIG. 18 6.—CELLULARIA AVICULARIA : *a*, natural size ; *b* and *c*, portions much magnified, showing the "birds' heads ;" *d*, a single polyzoon in its cell.

ciliated tentacula, and calculated only to receive such minute prey as is drawn within the ciliary vortex, it is difficult to see how this can be effected. Mr. Gosse has suggested a very ingenious explanation. The habit of seizing a passing animal, and holding it with a tenacious grasp until it dies, may be a means of attracting a supply of food into the vicinity.

The presence of decomposing animal matter in water invariably congregates crowds of infusory animalcules, which breed with astonishing rapidity, so as to form a cloud of living atoms around the decaying body, quite visible in the aggregate to the unassisted eye. An animal thus seized, therefore, becomes a centre to a crowd of infusoria, multitudes of which must be constantly drawn into the tentacular vortex and swallowed by the Polyzoon.

FIG. 187.—PLUMATELLA.

Besides the marine genera above described, there are many forms of animals, belonging to this class, that abound in our fresh waters. These **Fluviatile Polyzoa** are to be met with in ponds and streams, adherent to any foreign bodies that may be casually submerged. Thus, they are found attached to stones at the bottom of the water, upon shells, upon leaves—more especially those of the water-lily and the bistort—upon floating wood, and upon the stems of various plants. In order to examine these beautiful organisms in a living state, it is only necessary to allow the leaf, or other substance to which they are attached, to remain for some little time undisturbed in a glass of clear water, when they will be soon seen spreading forth their beautiful tentacula, as they protrude from their delicate cells; and by frequently changing the water they may be kept alive for months, affording objects of continual interest for microscopical observation.

When thus examined, it will be seen that the fresh-

water Polypes differ from the marine species in the arrangement of their tentacula. In the latter, as we have seen in *Bowerbankia* (Fig. 185), the tentacles are disposed in an uninterrupted series around the mouth, so as to resemble a funnel, whereas in the fresh-water species, they are arranged in a crescentic or horse-shoe-shaped series (Fig. 187).

CHAPTER XV.

SECOND CLASS OF MOLLUSCA.

TUNICATA.*

THE name of this class is derived from the circumstance that the animals belonging to it are enclosed in a tough, gristly or leathery bag, the lower extremity of which is generally affixed to some extraneous substance, such as a stone, a shell, or a piece of wood; while above it is provided with two orifices, one appropriated to the entrance, the other to the discharge of the surrounding water.

Various are the forms under which these creatures present themselves to the naturalist; from among

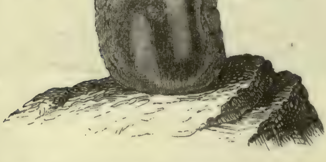


FIG. 188.—EXTERNAL FORM OF ASCIDIA.

* Tunica, *a coat*, so called because they are enclosed in a leathery looking *tunic*.

which we will select one of the simplest for special description.

The **Ascidians** (*Ascidia*)* (Fig. 188) are met with everywhere in abundance on the shores of the ocean, but very generally are passed unnoticed by the casual observer. In their natural condition, they are found fixed to the surfaces of rocks, seaweed, or other submarine bodies, and frequently glued together in bunches. Incapable of locomotion, and deprived of any external organs of sense, few animals seem more helpless and apathetic than these apparently shapeless beings; and the anatomist is sur-

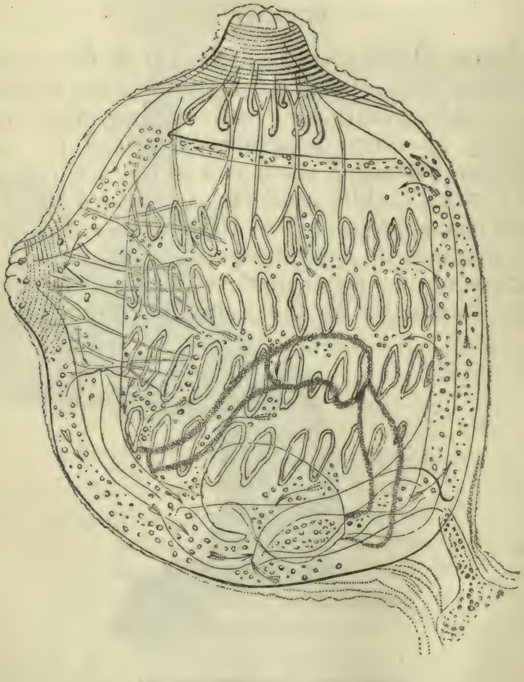


FIG. 189.—DIAGRAM OF STRUCTURE OF ASCIDIAN.

* ἀσκός, askos, *a leather bag.*

prised to find how remarkably the beauty and delicacy of their internal structure contrast with their rude external appearance. When we consider the immoveable condition of an Ascidian, and its absolute want of any prehensile instruments with which to seize prey, it is by no means easy to conjecture how it is able to subsist; neither is the structure of the mouth itself, nor the strange position that it occupies, at all calculated to explain this part of their economy. Their mouth is, in fact, situated at the bottom of a wide bag, into which the surrounding water is freely admitted. The internal surface of the bag is densely covered with cilia, which, in the living animal, are constantly in a state of rapid vibration, hurrying along whatever substances, alive or dead, may be brought into the body with the external element, and pouring them into the mouth, when they are immediately swallowed. Many forms of Tunicated Mollusca are met with in the seas of tropical latitudes, which, although allied to the Ascidians in the main points of their economy, differ from them in some particulars that require notice.

The **Salpians** (*Salpæ*) are some of them so transparent that their presence in even a small quantity of sea water is not easily detected. Their body is

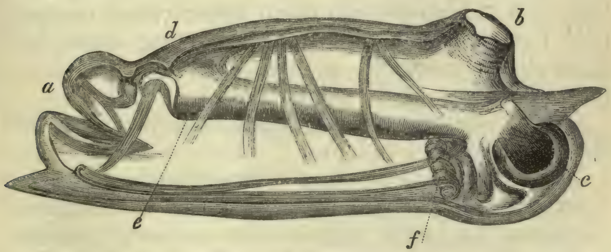


FIG. 190.—SALPA MAXIMA.

oblong, and open at both ends, the posterior opening being very wide, and furnished with a valve so disposed that water is freely admitted, but cannot again

be expelled through the same channel; so that, being forced, by the contraction of the body, in powerful gushes from the opposite end, it not only supplies materials for food and respiration, but impels the delicate animal through the water in a backward direction.

A very remarkable feature in the history of these creatures is, that many species are found swimming together adhering to each other, in long chains, and, what is still more strange, such aggregated animals give birth to solitary individuals of different appearance, which, in their turn, produce concatenated forms, so that a young Salpian does not at all resemble its mother or its daughter, but is the counterpart of its grandmother or its granddaughter.

The prodigious multitudes in which these creatures exist, may be gathered from the following extract:—

"Between the Cape and St. Helena, for many degrees and in bright, breezy weather, the ship passed through vast layers of sea water, so thronged with Salpæ (*S. mucronata*) as to present the consistence of jelly. These layers extended for several miles in length; what their vertical limits were it was impossible to discover. They appeared to extend deep. Each of these Salpæ measured about half an inch in length; but so close was their aggregation, that by a sudden plunge of an iron-rimmed tow-net, half the cubic contents, from which the water had drained, consisted of nothing but one gelatinous pulp."—*Voyage of Sir James Ross.*

Other Ascidians are aggregated together into still more complex assemblages.

The **Pyrosoma** (*Pyrosoma**), for example, is of this description. Its body is made up of multitudes of Ascidians so joined together as to form a hollow cylinder open at one end, but closed at the other. The cylinder thus constructed is rowed about in the sea by the combined contractions and expansions of all the animals composing it; and as it moves along,

* πῦρ, pyr, *fire;* σῶμα, soma, *a body.*

emits, at night, a most brilliant phosphorescent light, whence the derivation of the name by which it is distinguished. Nothing can exceed the dazzling splendour and brilliant colours exhibited by these floating cylinders—colours passing rapidly from a dazzling red to saffron, to orange, to green, and to

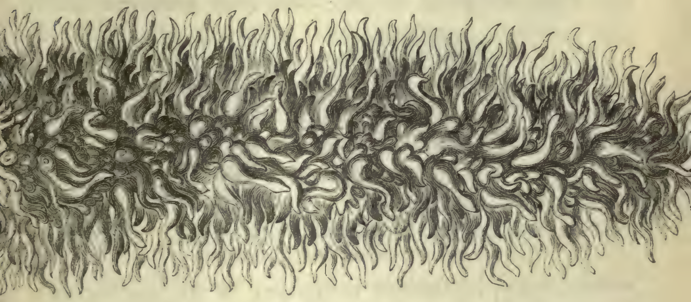


FIG. 191.—PYROSOMA.

azure, and thus reflecting every ray into which the prism divides the light, or which is exhibited by the heavenly bow.

If when walking on the sea-shore, about low-water mark, we turn over large stones, or look under projecting eaves of rock, we are almost sure to see translucent, jelly-like masses of various hues of orange, purple, yellow, blue, grey, and green, sometimes nearly uniform in tint, sometimes beautifully variegated, and very frequently pencilled as if with stars of gorgeous device, now encrusting the surface of the rock, now depending from it in icicle-like projections. These are

Compound Ascidians. A tangle or broad-leaved fucus torn from its rocky bed, or gathered on the sands, where the waves have cast it, will show us similar bodies, mostly star-figured, investing its stalks, winding amongst its roots, or clothing with a glairy coat the expanse of its foliated extremities. If we keep some of these in a vessel of sea water, we find they lie as apathetic as sponges, giving few symptoms

of vitality. A closer and microscopic inspection, however, will soon show us currents in the water surrounding them, streams rejected from their apertures, and water rushing in, indicating that, however torpid the creature may appear externally, all the machinery of life, the respiratory wheels and circulatory pumps, are hard at work in its numerous recesses. The

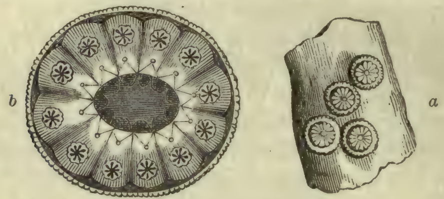


FIG. 192.—COMPOUND ASCIDIAN. STARRY BOTRYLLUS.* *a*, natural size; *b*, one of the composite stars magnified.

whole mass, in fact, is composed of an aggregation of minute Ascidians, conjoined in elegant microscopic groups, all constructed upon the same plan as that described above, and all actively employed in taking in and ejecting the currents that bring them nutriment.

CHAPTER XVI.

THIRD CLASS OF MOLLUSCA.

CONCHIFERA.†

THE inhabitants of bivalve shells constitute a very numerous and important class. Encased in dense and massive coverings, of such construction as to preclude the possibility of their maintaining more than a very imperfect intercourse with the external world, and deprived even of the means of communication with each other, we might naturally expect their organization to correspond in its general feebleness with the circumscribed means of enjoyment, and

* *βότρυς*, botrys, *a bunch of grapes.*
† Concha, *a shell;* fero, *I carry.*

limited capabilities of locomotion allotted to them. Numerous species are, from the period of their birth, firmly cemented to the rock that gives them support, as is familiarly exemplified by the common *Oyster*, or, else, as the *Mussels* anchor themselves securely, by unyielding cables of their own construction. The Scallop unattached, but scarcely better adapted for changing its position, rudely flaps together the valves of its expanded shell, and thus, by repeated jerks, succeeds in effecting a retrogressive movement; while the *Cockles*, destined to burrow in the sand, are furnished with a tongue-like foot, by means of which they dig holes, wherein they lie concealed, or crawl, or even leap about upon the shore. Many, as the *Pholades*, penetrate the solid rocks, and stones, and excavate therein the caverns they inhabit, or, as in the instance of the *Teredo*, with dangerous industry, bore into the bottoms of ships, or submerged wood of any description, and silently destroy, by their perfidious ravages, the piers or dikes that human labour has erected. The general structure of these animals may be readily understood by examining any of the species common in our markets. We will select

The **Scallop** (*Pecten*) for special description. On

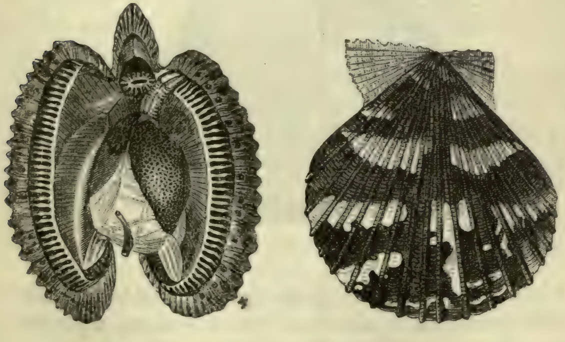


FIG. 193.—SCALLOP.

opening the shells of the Scallop, we see, inside each valve, first a thin and transparent membrane enclosing the entire animal. This is the *mantle.* Its edges are thickened and surrounded with a fringe of very sensitive fleshy filaments; they are likewise studded with glands that secrete a colouring matter exactly agreeing with the tints on the exterior of the shell, which they assist in ornamenting. Between the leaves of the mantle are placed the branchiæ, or gills, always four in number, formed of fringes pointing outwards, and free at their outer edges, so as to float loosely in the surrounding water. The mouth is placed between the two innermost gills at the point where they unite; it is a simple orifice, guarded by four thin and sensitive lips. Between the layers of the mantle is enclosed a fleshy organ, something resembling a tongue in its structure; this, though small in the Scallop, becomes in many genera of large dimensions, and assumes functions of great importance and interest. At the hinge or point where the two shells are united, there is a very elastic substance, the resiliency of which tends to force them apart. To counteract this, a stout, compact, and very powerful muscle proceeds from near

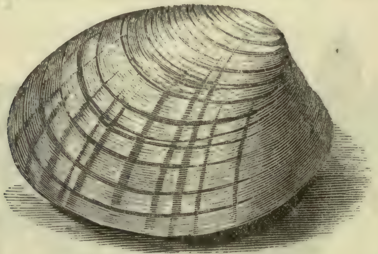


FIG. 194.—VENUS CHIONE.

the centre of one valve to that of the other, which, by its contraction, draws them together, and keeps them closed. When the animal wishes to open its shell, it relaxes this muscle, and the elastic ligament.

previously in a state of compression, forces them asunder. It is the contractile power of this muscle which renders it so difficult to open an oyster; the inserted knife cuts through the muscle, and it opens immediately. In a great majority of the Conchifera, there are two of these muscles placed far apart, as in the common Mussel. The hinge also, in many, is much more complicated, presenting a curious array of notches, and teeth, depressions and elevations that lock into each other.

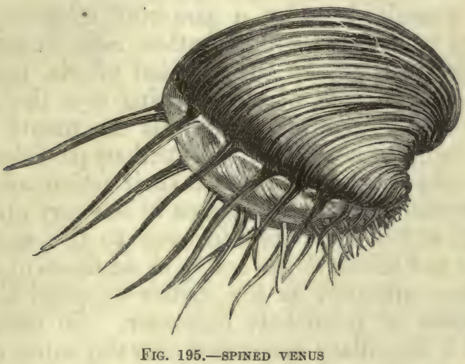


FIG. 195.—SPINED VENUS

In genera so constructed the ligament is placed upon the outside of the hinge, and opens the shell by its contraction, not by its expansion.

Whoever for a moment reflects upon the arrangement of the branchial apparatus, and the position of the mouth, consisting, as it does, of a simple aperture unprovided with any prehensile organs, must perceive that there are two circumstances connected with the economy of a conchiferous Mollusk, and those not of secondary importance, by no means easily accounted for. It is, in the first place, absolutely essential to the existence of these animals that the element in immediate contact with the respiratory surfaces should be renewed as rapidly as it becomes deteriorated, or suffocation would inevitably be the

speedy result. Secondly, it is natural to inquire how is food conveyed into the mouth? for in an animal, itself fixed and motionless, quite deprived of any means of seizing prey, or even of protruding any part of its body beyond the margins of its abode, it is not easy to imagine by what procedure a due supply of nutriment is procured.

Wonderful, indeed, is the elaborate mechanism employed to effect the double purpose of renewing the respired fluid, and feeding the helpless inhabitant of these shells. Every filament of the gill-fringe examined under a powerful microscope, is found to be covered with countless *cilia*, in constant vibration, causing, by their united efforts, powerful and rapid currents, which, sweeping over the entire surface of the gills, hurry towards the mouth whatever floating animalcules or nutritious particles may be brought within the limits of their action, and thus bring streams of nutritive atoms to the very aperture through which they are conveyed to the stomach, the lips and labial fringes acting as sentinels to admit, or refuse entrance, as the matter supplied be of a wholesome or pernicious character. So energetic, indeed, is the ciliary movement over the entire extent of the branchial organs, that if any portion of the gills be cut off with a pair of scissors, it immediately swims away, and continues to row itself in a given direction, as long as the cilia upon its surface continue their mysterious movements.

The Conchifera may be classed in accordance with the following Table:—

CONCHIFERA.	Having the mantle open, and without tubes or special apertures			**OSTRACEA.** Oysters.
	Having the mantle closed behind, so as to form special openings.	Not prolonged so as to form tubes. The mantle .	Open in front and having but one separate aperture for the escape of effete matter	**MYTILACEA.** Mussels.
			Closed and pierced by three apertures, the first of which serves for the passage of the foot, the second for respiration, and the third for the exit of excrementitious materials	**CHAMACEA.** Clams.
		Prolonged so as to form tubes. The mantle .	Open in front and presenting two tubes behind .	**CARDIACEA.** Cockles.
			Closed and having in front or below only a single opening for the passage of the foot, and two tubes behind	**INCLUSA.** Borers.

The first family of the Conchifera includes **Oysters** (*Ostracea*); these have no foot, and the mantle is entirely open; the shell is irregular, thick and foliated, and is generally fixed to some foreign body by the outer surface of one valve. The hinge is toothless, and the ligament is internal.

The **Common Oyster.** "The living luxury" is too well known to need description.

The **Tree Oyster** (*Ostrea arborea*), which in Africa is met with clinging in clusters to the exposed roots of the mangrove-trees that fringe the margin of all the great rivers in tropical climates, is, according to Adanson, as delicate and well tasted as our own. The negroes lop off a branch loaded with the shells,

obtaining, by one stroke of the axe, a large supply, for if the branch has many offsets, the load will be enough for any one man to carry.

The **File-shells** (*Lima*) usually live at the bottom of shallow seas, with the valves widely extended and

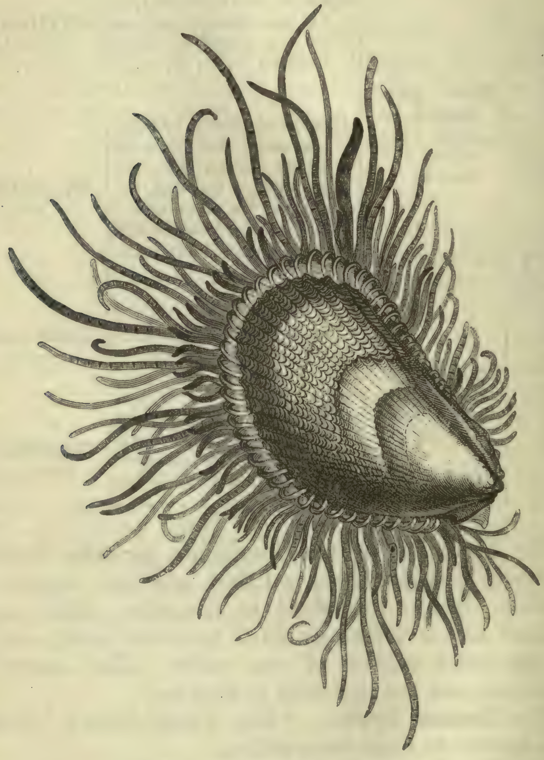


FIG. 196.—LIMA.

thrown flat back, like the wings of certain butterflies when basking in the sun; but when disturbed, they start up, flap their light shells, and move rapidly through the water, by a succession of sudden jerks.

The cause of their alarm over, they bring themselves to an anchor. When many hundreds of these curious bivalves are seen together in the recesses of clear pools, surrounded by living branches of parti-coloured corals, their crimson-spotted mantles and the fringes around them exhibit a very rich and beautiful spectacle.

The **Scallops** (*Pecten*) generally attach themselves to rocks, and sometimes cover extensive banks.

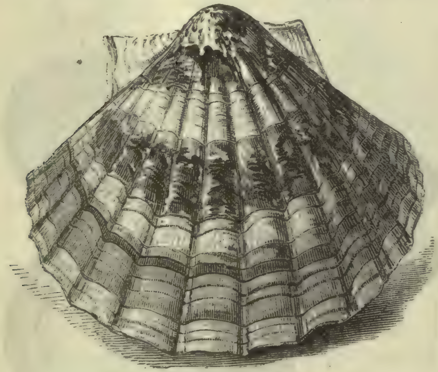


FIG. 197.—GREAT SCALLOP.

These bivalves are said to be able to see, and certain bright spots upon the margin of their mantle are believed to be eyes; indeed, one species has been named, after Juno's watchman, *the Argus*. Whether these brilliant pearl-like specks, so strangely situated, are really instruments of vision is, however, open to doubt.

The **Pearl-shells** (*Avicula*). To this family belongs the celebrated Pearl-Oyster. Their shells are imported in immense quantities, forming the celebrated "Mother of Pearl" so much employed in inlaying cabinet-work, making knife-handles, paper-cutters, and a thousand other pretty articles.

The Pearl-fishery is principally carried on in the neighbourhood of Ceylon and in the Persian Gulf.

The Pearl-Oysters are obtained by diving in about twelve fathoms. Many lives are annually sacrificed in pursuit of these highly-prized baubles.

The second family of **Conchiferous Mollusks** comprehends

The **Mussels** (*Mytilacea*), all of which are furnished with a foot, enabling them to creep about, and by its assistance they construct a cable composed of horny threads, called *Byssus*, whereby they attach themselves to rocks.

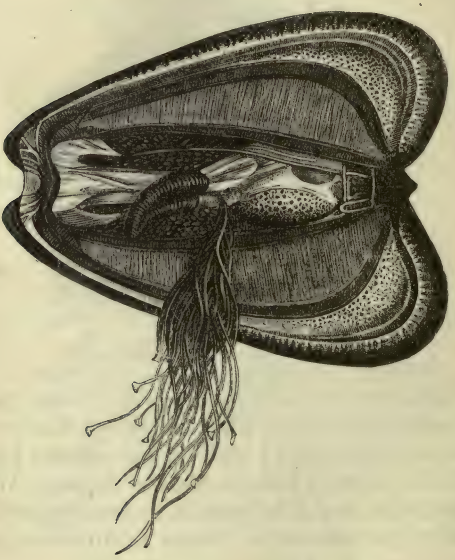


FIG. 198.—ANIMAL OF MUSSEL.

The **Wing-Shells** (*Pinna*) are remarkable for the fineness of their byssus. When mingled with about a third of real silk it is sometimes spun, and manufactured into gloves, &c., but they are merely objects of curiosity.

FIG. 199.—PINNA.

The true **Mussels** (*Mytilus*) are well known to everybody; they frequent mud banks which are uncovered at low water, are very prolific, and attain their full growth in a single year. By means of a strong byssus they fasten themselves to the rocks, where they defy the violence of the storm. "The mussel is the owl of the sea," says Charles Lamb; "Minerva's fish, the fish of wisdom. He hears the tide roll backwards and forwards over him twice a day, as the Salisbury coach goes and returns in eight-and-forty hours; but he knows better than to take an outside place on it."

The **River Mussels** (*Unio*) are met with in fresh-water lakes, rivers, and ponds throughout the whole world. In some of them pearls are found which are bright and of exquisite lustre; formerly, there were extensive fisheries of them both in Wales and Scotland. One taken from the river Conway, in North Wales, is to this day honoured with a place in the royal crown of England.

The third family of **Conchifera** embraces

The **Clams** (*Chamacea*), in which the two sides of

the mantle are conjoined so as to leave three apertures, through one of which the "foot" is protruded; a second is for the entrance and expulsion of

FIG. 200.—MUSSELS.

the water required for respiration, while through the third effete materials are rejected. These two last openings are not prolonged into a tube or respiratory syphon. To this family belong

The **Clam Shells** (*Tridacne*), the giants of the bivalve race; they live attached by their byssus to rocks, shells, and corals. The valve of a large individual forms a very picturesque basin for catching the clear falling water of a fountain, which flows prettily through its deeply indented edges. In Roman Catholic countries the valves of this huge shell are sometimes employed as "benitiers," or vessels for containing holy water. A pair so used may be seen in the church of St. Sulpice, in Paris, which weigh five hundred pounds, and are more than two feet across. Specimens attain even larger dimensions than these, and are the largest shells known. The byssus is so thick, and its attachment to the rock

so strong, that it is frequently necessary to cut it with a hatchet in order to obtain the animal.

FIG. 201.—CLAM SHELL.

These are the shells alluded to by Captain Flinders, who observes: "Many enormous cockles were scattered upon different parts of the reef. At low water this cockle seems most commonly to lie half open; but frequently opens with much noise, and the water within the shells then spouts up into a stream three or four feet high. It was from this noise, and the spouting of the water, that we discovered them, for in other respects they were scarcely to be distinguished from the coral rock. A number of these cockles were taken on board the ship, and stewed in the coppers, but they were too rank to be agreeable food, and were eaten by few."

The fourth family of **Conchiferous Mollusks** embraces

The **Cockles** (*Cardiacea*). These are distinguished by the mantle being open in front, and, moreover, by having two separate apertures, one serving for respiration and the other for the discharge of effete materials: these are prolonged into two tubes (Fig. 202), which are sometimes distinct from each other, but occasionally conjoined; and, as a general rule, those species provided with long tubes burrow into mud or sand. As examples of this family, we may instance

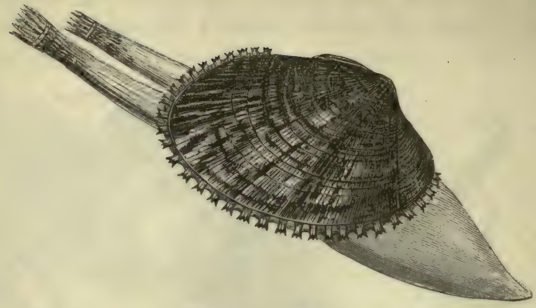


FIG. 202.—TELLINA.

The **Common Cockle** (*Cardium*), met with upon sandy shores in great abundance, where, under the name of "red noses," they constitute an important article of food. In the Cockles "the foot" is an organ of considerable size, assuming all sorts of shapes. Sometimes it is used for burrowing, for which it is admirably adapted. The animal lengthens the foot into a wedge, which it thrusts deep into the sand, and then, turning the end into the shape of a hook, and thus acquiring a hold, it drags itself down, and becomes buried so deeply, that only the projecting ends of the tubes, through which it breathes, are visible. By an opposite process, bending the end of the foot, and pushing against the sand, at the bottom of its hole, the shell is again extruded. At the bottom of the water the cockle can also move with considerable speed, by pushing with its foot against the ground as a ferryman poles his boat across a river. Nor is this all; for by stiffly bending the same wonderful organ, and letting it go by a sudden spring-like extension, some species can bound into the air and jump about with considerable activity. To this group belong the beautiful *Venus shells* (Fig. 195), the *Mactræ,* and a host of others of similar conformation.

The fifth family of Conchiferous Mollusks has received the name of

Inclusa (*Enclosed*), the animals having the margins of the mantle, with the exception of a single opening for the passage of the foot, completely united, so as

FIG. 203.—THE SANDGAPER.

to form a double tube, the end of which can be protruded to a considerable distance from the shell, that gapes more or less widely to give it passage. They almost all of them live buried in the sand, or else they bore into mud or even into the solid rock. To this family belong

The **Razor-shells** (*Solen*),* usually found in the sand, which they penetrate with their powerful foot. They are much valued for their excellence as articles of food. When properly cooked (broiling is the best method), they are by some thought to be superior to any other shell-fish. They lie in their holes nearly in a vertical position, and move up and down in their burrows, sometimes rising to the surface as if to see what is going on in the world above. When the tide goes out they sink deeper. The fishermen then endeavour to tempt them out, as little boys would catch birds if they could, by putting salt on their tails. The salt irritates the extremity of their siphons, and the Solen rises suddenly to get rid of the nuisance. The vigilant human enemy watches the moment, and seizes the opportunity—and the

* σωλήν, solen, *a tube.*

Solen—if he can catch it; but unless very quick in his movements, those of the Solen may be quicker, and once aware of the impending danger, the sensible shell-fish will not come up again, but submits

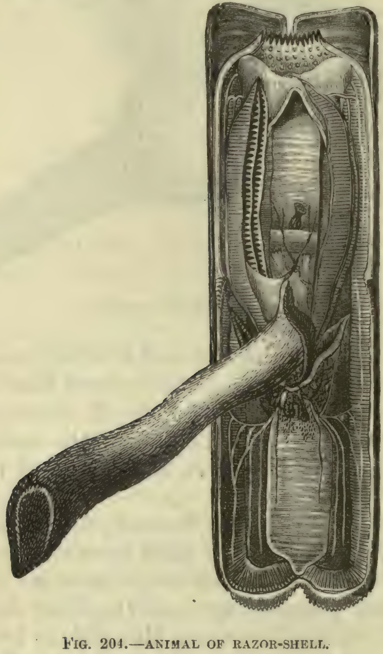


FIG. 204.—ANIMAL OF RAZOR-SHELL.

patiently to be salted alive rather than run the risk of being caught and roasted, or else cut up for a bait. —Professor EDWARD FORBES.

The **Stone-borers** (*Saxicava*)*. These shell-fish generally bore in limestone rocks. Wherever we have a sea-coast of mountain limestone, the substance of the rock is almost invariably riddled by them. Some years ago it was discovered that the whole front of the Plymouth breakwater had been attacked by these excavators, and great alarm was excited for its safety. Luckily they do not drive their tunnels

* Saxum, *a stone;* cavo, *to scoop, to bore through.*

more than six inches deep, so that unless there be a

FIG. 205.—SAXICAVA.

new surface exposed by the destruction of the perforated part, there is not much danger to be apprehended from them.

The **Pholades*** are likewise borers. They excavate

FIG. 206.—PHOLADES.

* φωλεύω, pholeuo, *to lie in a hole.*

for themselves the dens in which they reside, in stone, clay, wood, or other substances, and in these excavations they live a sedentary life. Their shell is generally thin and brittle, but it is extremely hard, and covered externally with file-like teeth, that seem to constitute the tools employed in their boring operations.

The **Ship-worm** (*Teredo*),* well characterized by Linnæus as the "calamitas navium," seems to have been specially appointed by Providence for the removal of floating timber, which otherwise, by its accumulation, might impede the navigation of the sea. The mantle is excessively lengthened into a sort of tube, while the valves are minute, so that the appearance of these bivalves is rather that of a Worm than of a Mollusk. It bores holes in all directions through wood lying in the sea, lining

FIG. 207.—SHIP-WORM AND ITS SHELL.

the interior of its excavations with a shelly crust. The piles of piers and wharves, the gates of docks, and the bottoms of ships are soon riddled and pierced by these animals, insomuch that serious fears have been more than once entertained for the safety of

* τερέω, tereo, *to bore.*

Holland, from their destructive attacks upon the wood of the flood-gates and dykes. A few weeks' immersion of a piece of fir-wood suffices to enable the Teredo to bore it through and through, and even the hardest oak is not able to resist this formidable destroyer.

CHAPTER XVII.

Fourth Class of Mollusca.

Brachiopoda.*

This is a very limited group, the members of which might readily be supposed at first sight to belong to the ordinary bivalves described in the last chapter. They are contained within a pair of shells, more or less resembling those of the common cockle. One shell,

Fig. 208.—Figure of Brachiopod.

however, is larger and more convex than the other, and is generally pierced with a hole near the hinge. The shells are for the most part fixed to some rock or other object by a fleshy stalk, but in one genus (*Orbicula*) the lower valve itself is cemented to the rock.

* βραχίων, brachion, *an arm;* πούς, ποδός, pous, podos, *a foot—arm-footed.*

On opening the shell the structure of the enclosed Mollusk is at once seen to differ widely from that of the Scallop and all the Conchiferous class. On each side of the mouth, which is placed at the bottom of the fold of the mantle, extends a fleshy arm, fringed with long cilia. In some species, these arms are of great length, and can be protruded from the shells to a considerable distance, or retracted into elegant spiral folds at the pleasure of the animal.

The most obvious function attributable to the tentacular arms is that of procuring food; for being otherwise deprived of prehensile instruments, without some adequate mechanism these helpless creatures, imprisoned in their shelly covering, and fixed in one locality, would be utterly unable to obtain nourishment necessary for their support. The contrivance for this purpose is found in the arms, which, covered by cilia, produce powerful currents in the surrounding water, and these, being directed towards the mouth as to a focus,

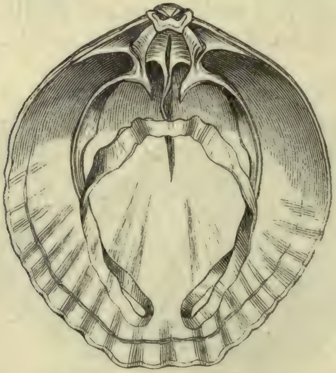


FIG. 209.—SHELLY FRAMEWORK OF BRACHIOPOD.

hurry down the throat of the animal whatever nutritive particles may happen to be in the neighbourhood. The muscles supplied for closing the shell in the Conchifera are never more than two in number, and these pass immediately from one valve to the other: in the Brachiopods, on the contrary, the muscular system is very complicated, no fewer than six pairs being provided either to act upon the valves or to move the animal upon its pedicle. Their shells, moreover, contain a complex framework for the support of the arms (Fig. 209). Seeing, therefore, that these creatures differ from all other bivalves in almost every part of their structure, there can be little doubt of the propriety of considering them as forming a distinct class.

CHAPTER XVIII.

Fifth Class of Mollusca.

Gasteropoda.*

The Gasteropod Mollusks are so named on account of the peculiarity of their locomotive apparatus. The inferior surface of the body is spread out into a broad fleshy disk or *foot*, on which the animal crawls with an uniform gliding motion. The back is covered more or less completely with a mantle, which in the great majority of species secretes a shell. In some, as in several of our native slugs, the shell is very

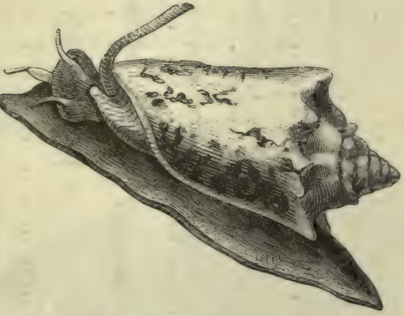


Fig. 210.—Volute crawling.

small, and is concealed within the substance of the short mantle. But in general, as in the Snail and the Whelk, the shell is capacious, capable of receiving and concealing the whole body. The form is commonly that of a long cone, twisted in a spiral manner upon itself.

The innumerable species belonging to this extensive class are distributed by Cuvier under several orders distinguished by the structure and position of their organs of respiration, as in the following tabular arrangement:—

* γαστήρ, gaster, *the belly*; πούς, ποδός, pous, podos, *a foot*.

GASTEROPODA.	Breathing air				PULMONIFERA.
	Breathing water. Foot flat and formed for crawling.	Branchiæ concealed	In a dorsal cavity. Shell	Almost always turbinate	PECTINIBRANCHIATA.
				Tubiform	TUBULIBRANCHIATA.
				Very open, ordinarily in form of a shield	SCUTIBRANCHIATA.
			Beneath a fold of the mantle, which almost always contains a shell, or beneath a straight edge of the foot		TECTIBRANCHIATA.
		Branchiæ naked & fixed	Beneath the edge of the mantle	Shell not turbinated, of one or more pieces	CYCLOBRANCHIATA.
				Without a shell	INFEROBRANCHIATA.
			Upon the back		NUDIBRANCHIATA.
	Foot vertically compressed, and only fit for swimming				HETEROPODA.

The **Air-breathing Gasteropods** (*Pulmonifera* *) of which the Slug and the Snail are familiar examples, respire atmospheric air, which is alternately drawn into and expelled from a cavity lined with a most delicate net-work of blood-vessels: this respiratory organ opens externally on the right side of the body, near the margin of the shell, below the collar of the mantle. Some are terrestrial, others live in streams or in sluggish stagnant waters, some are shelled, others are naked.

The **Terrestrial Air-breathing Gasteropods** are at once recognizable by their *four* tentacula or *horns*, as they are commonly called. These appendages are retractile, and the upper pair have eyes at their extremities. The mouth is armed with a broad cutting tooth, and a wonderfully-constructed tongue, studded with innumerable microscopic teeth. Some are only provided with an internal shell, while others have an external shell spirally twisted.

The **Slugs** (*Limax*) are without any apparent shell;

FIG. 211.—SNAILS AND SLUGS.

* Pulmo, *a lung*; fero, *to carry*.

their mantle is a fleshy disk scarcely separated from the rest of the skin, and only occupies the forepart of the back, where it covers the pulmonary cavity. It often encloses in its thickness a small flat shelly plate. These animals are herbivorous; they feed principally upon young plants, fruits, mushrooms, &c., and are most voracious towards evening. During the heat of the day they remain concealed under stones, or beneath some heap of half-decayed leaves, or even in the earth, and they seldom come out except in the morning and evening when the air is humid; they are especially abundant after rain. During the cold season they bury themselves in the ground and remain torpid.

The **Snails** (*Helix*) have a complete and apparent shell. Their structure differs very little from that of the Slugs, and their habits are nearly the same. In summer they are very voracious and destructive, but

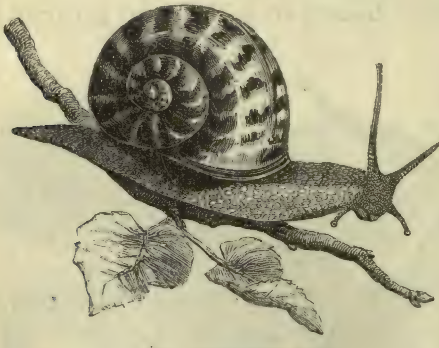


FIG. 212.—GARDEN SNAIL.

in autumn they eat little. On the approach of winter they retire into some hole and draw themselves into their shell, shutting up the aperture with a kind of door secreted by the edge of the mantle. The species of Snails are very numerous; they are found in all parts of the world.

The **Aquatic Air-breathing Gasteropods** have but *two*

tentacles; their mode of respiration obliges them to come frequently to the surface of the water to breathe. They consequently cannot keep at great depths, and ordinarily reside in fresh waters or near the mouths of rivers.

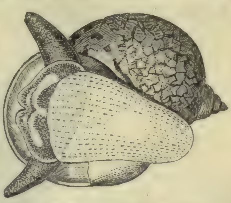


FIG. 213.—LIMNÆUS AURICULARIS.

The **Pond Snails** (*Limnæus*), common in every pond, live upon vegetables and the seeds of water-plants, and for this purpose are provided with a strong muscular gizzard.

The **Flat Coils** (*Planorbis*) are recognised by their shells being rolled up spirally in the same plane, like a French horn. Their habits are similar to those of the Pond-snails, of which they are the constant companions. Their presence in an aquarium is useful, inasmuch as they destroy voraciously the green confervæ, that otherwise are apt to accumulate on the sides of the glass.

FIG. 214—PLANORBIS CORNEUS.

ORDER PECTINIBRANCHIATA.*

The **Comb-gilled Gasteropods** (*Pectinibranchiata*) constitute by far the most numerous order of the class. They are so called because they breathe by means of gills disposed in the form of a comb, and arranged in one or two rows suspended from the interior of a chamber or cavity, situated in the last-formed or most capacious whorl of the shell, and communicating with the surrounding element by means of a wide channel or tube called the *siphon*. The multitudinous species of marine Mollusca that inhabit spiral or univalve shells belong to this order. Many of them have a shelly or horny plate attached to the hinder part of their body called the *operculum:* this accu-

* Pecten, *a comb;* branchiæ, *gills—comb-gilled.*

rately fits the orifice of the shell, to which it serves as a door, when the animal withdraws into its habitation.

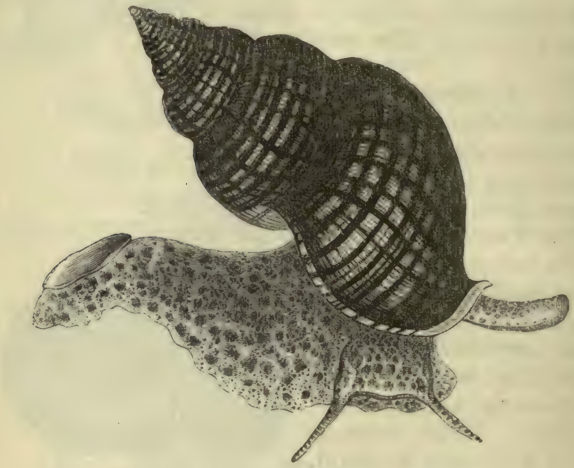


FIG. 215.—THE WHELK, SHOWING ITS OPERCULUM.

All the Pectinibranchiate Mollusks have two tentacles and two eyes, sometimes supported on special foot-stalks. Their mouth is in the form of a tube or proboscis, capable of being protruded by a very peculiar mechanism, and furnished at its extremity with a kind of file, by the aid of which they bore through the shells of other Mollusca, notwithstanding the massiveness of the defensive armour of their victims. Their eggs are very numerous, and are generally enclosed in cases of complicated form and very curious structure.

The beauty, and more especially the rarity, of the shells of many species have often caused them to bear a very high adventitious value. The elegant Chinese shell, known as the Royal Staircase or Wentle-trap, derived its specific name (*Scalaria pretiosa*) from the high price at which large and fine specimens were sold. One was purchased in France for a hundred pounds sterling, and in England

from twenty to thirty pounds have been given for a good specimen. The shell is now far from rare, and shillings take the place of pounds in the purchase.

FIG. 216.—THE WENTLE-TRAP.

The **Violet Shells** (*Janthina*), in their external appearance, very much resemble our garden snails, and are not furnished with an operculum. Instead of this, however, they possess a very curious apparatus attached to their rudimentary foot, composed of a substance resembling horny froth, that serves as a float, whereby they are sustained at the surface of the sea, and to which as to a raft the Janthina fastens its eggs. These Mollusks are common in the Mediterranean: on touching them they emit a violet-coloured fluid that dyes the water around them of a deep purple colour.

The **Cone Shells** (*Conus*) (Fig. 217) are remarkable for their conical shape and the flatness of their spire, as well as for the extraordinary beauty and brilliancy of their colours. These shells, in Africa, in regions far from the sea, are considered of as great value as the Lord Mayor's badge is in London, and are so highly prized as evidences of distinction, that for two of them a slave may be bought, and five would be considered a handsome price for an elephant's tusk worth ten pounds.

The **Cowrie Shells** (*Cypræa*), many of which form

the ornaments of our chimneypieces, and the gems of our cabinets, are of very peculiar structure. In the earlier period of their growth they much re-

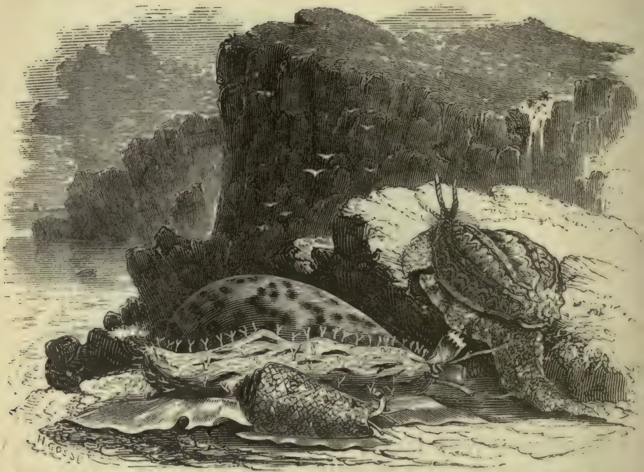


FIG. 217.—TIGER COWRY (*Cypræa tigris*), HARP (*Harpa ventricosa*), AND CLOTH-OF-GOLD CONE (*Conus textilis*).

semble the Cones mentioned above; but when they have arrived at a certain size, the mantle of the contained Mollusk spreads over the entire external surface and covers it with a porcellanous coat quite

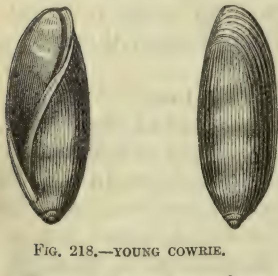


FIG. 218.—YOUNG COWRIE.

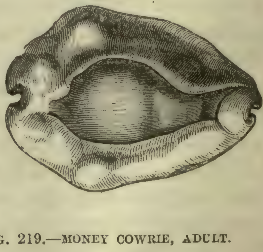


FIG. 219.—MONEY COWRIE, ADULT.

different in colour from the original shell, and this, joined to the changed appearance of the opening, might cause the adult to be mistaken for a different species.

The Cowrie shells are employed by Asiatic islanders to adorn their dress, to weight their fishing-nets, and for barter. Specimens of them were found by Dr. Layard in the ruins of Nimroud. The Money cowrie (*Cypræa moneta*) is used as money by the Africans: hundreds of tons are imported to Liverpool and exported for barter.*

The **Harp-shells** (*Harpa*) are recognisable by the prominent ribs upon their surface, the last of which forms the marginal border. These shells are very beautiful; the animal (Fig. 217.) is furnished with a large foot, broad in front, and pointed posteriorly; its tentacles are provided with eyes situated near their bases; it has no operculum.

The **Helmet-shells** (*Cassis*) are of an oval shape,

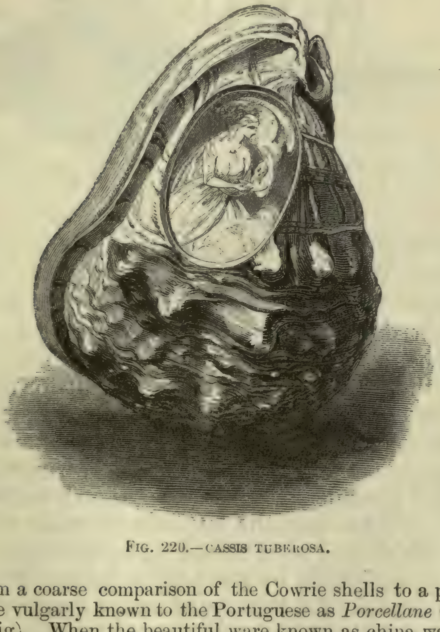


FIG. 220.—CASSIS TUBEROSA.

* From a coarse comparison of the Cowrie shells to a pig's back, they were vulgarly known to the Portuguese as *Porcellane* (*Porcellus*, a little pig). When the beautiful ware known as china was first imported, the resemblance of its glaze to the enamel of the Cowrie shell caused it to be called "Porcelain."

and have their opening long and narrow. The large and massive shells of some species are used for the manufacture of cameos, which are cut out of their thick substance, as represented in the accompanying figure (Fig. 220). The subject is worked in relievo in the white portion or outer table of the shell, while the inner layer, generally of a pink or reddish-brown tint, is left for the background.

The **Rock-shells** (*Murex*) are ornamented with spines, rough tubercles, or leafy, frilled, processes, arranged in a regular but peculiar order. The species which we have figured (*Murex tenuispina*) is common

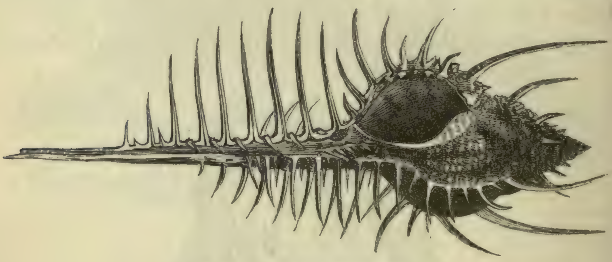


FIG. 221.—THORNY WOODCOCK.

in cabinets, and known to collectors by the name of the Thorny Woodcock.

A purple liquor, capable of producing a rich and permanent dye, is known to be produced by many Gasteropods; but various species of the animals inhabiting these rock shells are pre-eminent for this property. Accordingly we are told that they furnished the first colour which mankind was enabled to fix permanently on wool and linen. While a certain person, called Hercules, strolled along the shore with his lady-love and her dog, the latter in its sport mouthed a shell, which had been tossed up by the waves, and had his lips coloured by the purple juice. The lady, enchanted with the beauty of the colour, yearned for a dress of the same purple, and the wish sufficed to call into exercise the ingenuity of her lover, who

succeeded in dyeing her a garment. The Tyrian purple was perhaps the principal commodity of Tyre when her "Merchants were princes, and her traffickers the honourable of the earth."

FIG. 222.—GRANULATED TROCHUS.

The dyeing material is contained in a tube of yellow or cream-colour that runs diagonally across the body of the Murex. If this be cut with a sharp pair of scissors it gives issue to a creamy substance, which is the colouring fluid. When applied over linen with a camel-hair brush, the hue is at first a rich "king's yellow," but changes in a few minutes to a delicate pea-green. In about an hour, if the weather be cloudy, it has become of a yellow grass-green, from which it slowly turns to a blue green, thence to indigo, then to blue—a red tinge now becomes apparent—then violet, then a purple, more or less tinged with red, till at length, after five or six hours, without direct sunlight, it assumes its final tint, a rather dull purplish crimson or lake. The direct beams of the sun greatly hasten the process.

There have been found on the shore near the ruins of Tyre a number of round holes cut in the solid rock, varying in size from that of an ordinary metal pot to that of a large boiler. Within these, and on the beach, were a great number of shells broken apparently by design. It is hence supposed that the animals were pounded in these mortars for the

purpose of extracting the colouring fluid, especially as Pliny describes this as being the mode in which the dye was obtained. The shells, when examined, proved to be those of *Murex trunculus*, still found abundantly on the neighbouring beach.

The **Stromb-shells** (*Strombus*) have the siphonal canal straight, or inflected towards the right side. The external border of the opening of these shells expands with age, and sometimes spreads out into

FIG. 223.—PELICAN'S FOOT STROMBUS.

long, finger-like prolongations, so that, when they arrive at maturity, their form is very different from that of the young. Some species belonging to this carnivorous genus are also remarkable for their great size, as, for example, the common Conch-shell (*Strombus gigas*) of the West Indies, valued as a chimneypiece ornament on account of its striking appearance, and the beautiful rosy hue of its interior.

ORDER TUBULIBRANCHIATA.*

In this order of Gasteropods the shell takes the form of a tube, more or less irregular in its shape, but always presenting a spiral contour near its commencement. These tubes very much resemble those of certain Annelidans (*Serpulæ*), with which they were long confounded. They are generally found entwined together, and mixed up with coral beds. As the included animals are thus fixed,

* Tubulus, *a tube;* branchiæ, *gills—tube-gilled.*

they have no *foot;* but that part of their bodies, which, in ordinary Gasteropods, constitutes the tail,

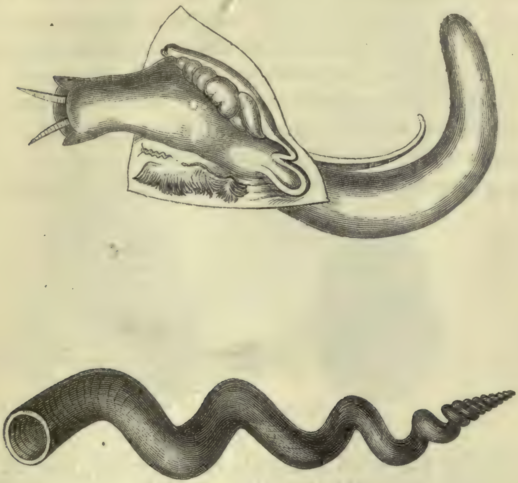


FIG. 224.—VERMETUS.

is bent forwards until it reaches beyond the head, where it swells out into a protuberance furnished with a thin operculum; this serves as a door wherewith to close the entrance of the tube when the animal retreats into its shelter. The head of these Mollusks is provided with two tentacula of moderate size, at the bases of which the eyes are situated: the mouth is a simple vertical slit (Fig. 224).

ORDER SCUTIBRANCHIATA.*

The animals belonging to this order have their shells very widely open, and frequently not at all spiriform, so that they cover the back, as it were, with a broad shield.

The **Sea-ears** (*Haliotis*) are the most beautiful and richly ornamented of the group; their shell is slightly spiral at its commencement, but rapidly expands, so

* Scutum, *a shield;* branchiæ, *gills—shielded-gills.*

as somewhat to resemble in its shape the human ear, whence the origin of the name. The circumference of the foot, and the sides of the head of the living animal, are decorated with elegant fringes, and the shell is likewise perforated with a row of apertures through which gorgeously-coloured filaments are protruded: these apertures also serve for the free admission of water to the branchial chamber. The mouth is a short proboscis.

The **Key-hole Limpets** (*Fissurella*) very much re-

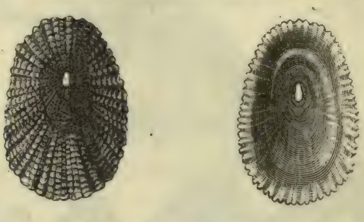


FIG. 225.—FISSURELLA RETICULATA.

semble the common Limpets of our coast, and in like manner are provided with a plain conical shell, without any spire, which spreads over the middle of their back. They differ from the Limpets, however, in having the shell perforated at its apex for the purpose of admitting the water into a branchial chamber in which pectinated gills are lodged.

ORDER TECTIBRANCHIATA.*

The Gasteropods belonging to this order have their branchiæ arranged along the right side of the body, or on the back; they are always in the form of leaflets more or less divided, but not symmetrical: they are protected by a sort of roof, formed by a prolongation of the mantle. These animals are for the most part naked slugs; but some have a small shell concealed in the mantle, and others have a conspicuous one of considerable size: we select as an example of this order

* Tectus, *covered;* branchiæ, *gills—covered-gills.*

The **Sea-Hares** (*Aplysia*) frequently found in fishermen's nets. When captured and put into a vessel of water, they have the power of discharging,

FIG. 226.—SEA-HARE.

in great abundance, a fluid of a rich purple hue, which quickly diffuses its colour through the water. The Sea-Hare is a harmless creature that lives entirely upon seaweeds and fuci; nevertheless, it was formerly dreaded as a most potent poison, and strange tales are told of the atrocities committed by its agency.

ORDER INFEROBRANCHIATA.*

These Gasteropods very much resemble Slugs in their general appearance, but their branchiæ consist of leaflets arranged like a fringe, along both sides of the body, protected by the border of the mantle, which is of a leathery texture, and without any shell: their mouth is a little proboscis, provided on each side with a short tentacle (Fig. 227).

* Inferus, *below*; branchiæ, *gills*—gills situated at the under part of the body.

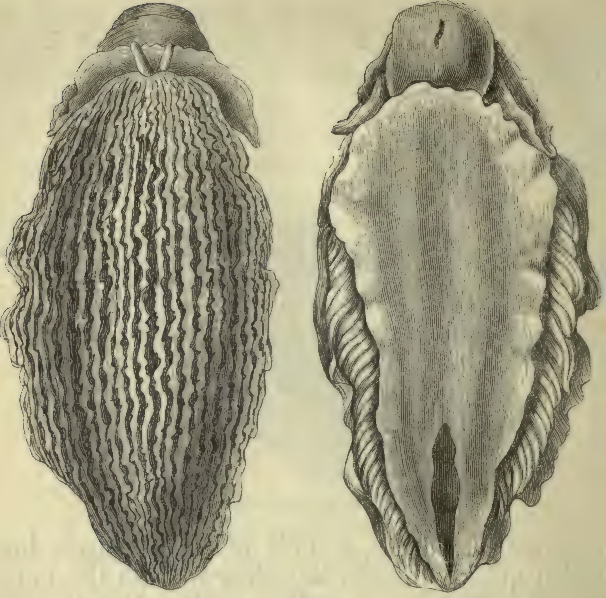


Fig. 227.—PHYLLIDIA.

Order Cyclobranchiata.*

In this order the gills consist of a series of laminæ or pyramidal appendages, extending quite round the body beneath the edge of the mantle (Fig. 228). It embraces

The **Limpets** (*Patellæ*), the appearance of which is well known to every sea-side visitor.

Fig. 228.—LIMPET.

* κύκλος, cuclos, *a circle* ; branchiæ, *gills*.

The **Coat-of-Mail shells** (*Chiton*) are of very remarkable structure; their body is covered by eight overlapping shelly plates, surrounded by a tough leathery margin, often studded with little scales or spines or hairs, under the protection of which the branchiæ are situated. The flexibility of their armour is such, that they are enabled to roll themselves up into a ball, and their head is quite unprovided either with eyes or tentacula.

FIG. 229.—TUFTED TRITON.

ORDER NUDIBRANCHIATA.*

The animals belonging to this order are marine slugs, unprovided with a shell, and breathing by means of branchiæ, placed upon their backs, and thus exposed, naked, and unprotected, to the influence of the surrounding medium (Fig. 230).

Several species of these naked-gilled Mollusca are common on the British coasts. They exhibit a very great diversity of form, and an extraordinary variety

FIG. 230.—CROWNED EOLIS

of lively and beautiful colours. The gills are contractile into cavities on the surface of the body, and present, in the living state, extremely interesting objects, as the animals keep extending and with-

* Nudus, *uncovered;* branchiæ, *gills—naked-gilled.*

drawing them at frequent intervals. In some they present the appearance of flowers, as in Doris (Fig. 231); in others they are arborescent, or tree-

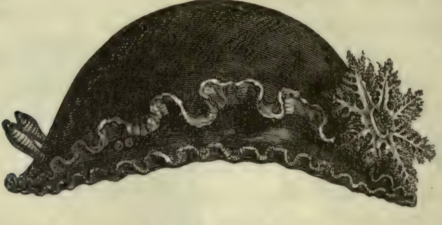


FIG. 231.—HORNED DORIS.

like, or feathered like an ostrich-plume; and in some they are disposed in rows, on the sides of the body. The greater number of these sea-slugs are carnivorous, and appear to be very voracious. They feed chiefly upon zoophytes and sponges, some adding to their bill of fare the gelatinous Medusæ, that are found floating near them, while occasionally they have been seen devouring other Nudibranchs.

The spawn of the Nudibranchiate Gasteropod is deposited in the shape of a gelatinous band, always

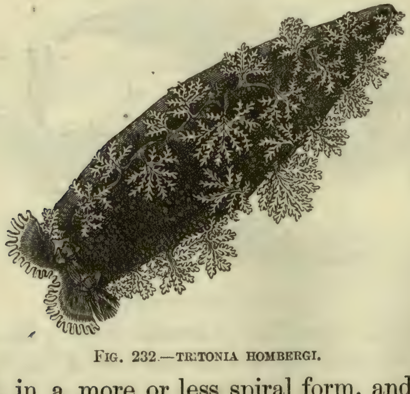


FIG. 232.—TRITONIA HOMBERGI.

arranged in a more or less spiral form, and fastened by one of its edges to Corallines or the under surface of a stone. The eggs are minute and very numerous,

amounting in some species to several thousands. Before the period of exclusion, the young may be seen revolving by means of vibratile cilia, and on escaping from the egg, they swim about freely in the water by the same means. The embryo is extremely minute,

FIG. 233.—YOUNG OF EOLIS.

and looks more like a Rotifer than a Mollusk; moreover, to add to its extraordinary appearance, it is enclosed in a transparent Nautilus-like shell, provided with an operculum.

ORDER HETEROPODA.*

In these Gasteropods, the foot, instead of forming a flat horizontal sole, has a vertical direction, and assumes the figure of a compressed fin, which being moved by its own muscles from right to left, propels the animal forward, like a sculler who works his boat with a single oar. In the Carinaria (beautiful creatures, clear as crystal and painted with the liveliest colours) this ventral fin is aided in its office by some subsidiary membranes situated upon the neck, or near the tail. Combined, they give these animals a velocity superior to what has been noticed in any other tribe of Mollusks. They are, indeed, quite remarkable for their quickness, propelling them-

* ἕτερος, heteros, *of another kind*; πούς, ποδός, pous, podos, *a foot*.

selves forward or backward, in a straight line or a curved one, with equal facility. But the Heteropods

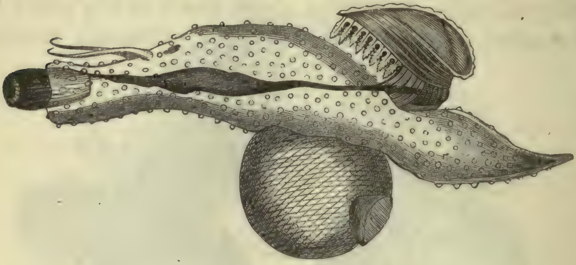


FIG. 234.—CARINARIA.

need occasional repose, and a cessation from activity; and admirably is the foreseen want provided against. Where are they to rest? Where fix their anchor in the world of unstable water around them? They are created to live, and are born amidst the fields of seaweed, which voyagers describe with amazement, as covering leagues of sea within the tropics;* and to enable them to attach themselves to the narrow leaves of this "gulf weed" (*Sargassum*), they are furnished with a small sucker, which, like a cupping-glass, applied against the surface of the leaf, suspends them without exertion. This little sucking disk is situated on the upper and hinder margin of the fin.—DR. JOHNSTON.

* The gulf-weed forms a floating continent. In steering towards the equator it is usually first observed in fields and islands near the coast of Madeira, whence it spreads to the Gulf of Mexico, and the Caribbean Sea. After sweeping round these shores, it escapes by the Gulf of Florida, whence it progresses towards the Azores. There is a similar circulation of gulf-weed in the southern hemisphere.

CHAPTER XIX.

SIXTH CLASS OF MOLLUSCA.

PTEROPODA.*

THE Pteropoda are of small dimensions, but met with in astonishing quantities, at certain seasons, in various parts of the ocean. So numberless, indeed, are these little beings in those regions where they are common, that the surface of the sea seems literally alive with their gambolings; and thus the store of provisions necessary to render the waters of the ocean habitable, for animals of higher grade in the scale of life, is still further increased. The great character which distinguishes this class is derived from the structure of their locomotive apparatus. This is only adapted for swimming, and consists of two broad fleshy expansions, attached like a pair of wings to each side of the neck, forming moveable fins, by the aid of which these little beings dance merrily among the foaming waves, now sinking, and again rising to the surface, until some passing whale, opening its enormous jaws, engulfs multitudes of such tiny prey, and terminates their brief existence.

The two wing-like expansions, although they externally appear to be separate instruments, are in reality but one organ, being made up entirely of muscular bands that pass right through the neck, and spread out on each side, in the substance of the wing, forming an apparatus exactly comparable to the double-paddled oar with which the Greenlander so dexterously steers his kajac or canoe through the very seas inhabited by the little creatures we are describing. We select as examples of this order

* πτερόν, pteron, *a wing;* πούς, ποδός, pous, podos, *a foot—wing-footed.*

The **Northern Clio** (*Clio borealis*), an animal not more than an inch in length (Fig. 235), but of truly marvellous structure. On each side of the mouth are three conical appendages that to a superficial observer appear to be mere fleshy tentacula, but in reality they are instruments of prehension of unparalleled beauty and astonishing construction. Each of these six appendages when examined with the naked eye is of a reddish tint; but when examined under the microscope this colour is found to be

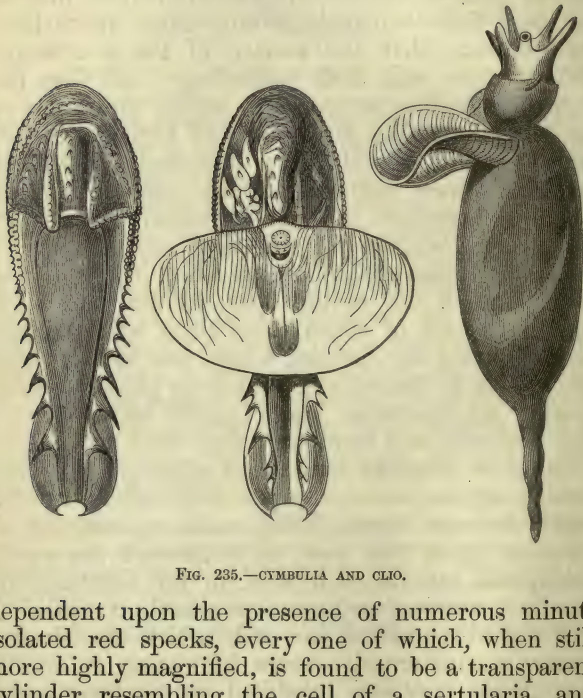


FIG. 235.—CYMBULIA AND CLIO.

dependent upon the presence of numerous minute isolated red specks, every one of which, when still more highly magnified, is found to be a transparent cylinder resembling the cell of a sertularia, and containing within its cavity about twenty suckers adapted to seize and hold minute prey: the number of these red specks is calculated to be about three thousand; so that there are at least $(3000 \times 20 \times 6)$

360,000 of these microscopic suckers upon the head of one *Clio*—an apparatus for prehension perhaps unparalleled in the animal creation. When not in use, the appendages referred to are withdrawn and concealed by two hood-like expansions that completely cover and protect the whole of this delicate mechanism.

The **Limacina helicina** (Fig. 28) is another species found in company with the above, in even still more innumerable hosts. It does not materially differ from the Clio in its general structure, but its body is enclosed in a transparent spiral shell of exquisite delicacy. This beautiful little Pteropod uses its shell as a boat, and by means of its wing-like fins rows itself about on the surface of the water.

The **Hyalæa** (Fig. 236) is an inhabitant of warmer

FIG. 236.—GLASS SHELLS (*a. Hyalœa tridentata* ; *b. Cleodora pyramidata*).

regions; its shell is somewhat like that of a bivalve without a hinge, the hinder part being consolidated and armed with three spines. At the sides are narrow fissures, through which membranous expansions are protruded, resembling those of the Clio.

The **Cleodora** (Fig. 236) is another exceedingly delicate and beautiful example. The shell of this little creature is of glass-like transparency, very fragile and somewhat in the form of a triangular pyramid. The animal in the dark is vividly luminous, and presents a very striking appearance as it shines through its pellucid lantern.

"The Pteropods," says Mr. Godwin Austen, "are

the winged insects of the sea, reminding us, in their free circular movements and crepuscular habits, of the gnats and moths of the atmosphere; they shun the light, and if the sun is bright you may look in vain for them throughout the live-long day. It is only as day declines that their true time begins; and thence onwards the watches of the night may be kept by observing the contents of the towing-net, as the hours of a summer's day may be by the floral dial. The *Cleodoræ* are the earliest risers. As the sun sets, *Hyalæa gibbosa* appears, darting about as if it had not a moment to spare, and indeed its period is brief, lasting only for the Mediterranean twilight. Then it is that *Hyalæa trispinosa* and *Cleodora subula* come up. Some species retire early, while others are to be met with only during the midnight hours, and in the darkest nights. There are, however, a few of irregular habits, who manage to keep it up the whole night through. All, however, are back to their homes before day surprises them."

CHAPTER XX.

Seventh Class of Mollusca.

Cephalopoda.*

From the strange combination of characters employed to designate the last and highest order of the Mollusca, the student will, no doubt, be prepared to anticipate something remarkable in their habits and appearance; nor will his expectations be disappointed.

Their body is enclosed in a muscular sac or bag, which in many species is provided with fleshy fins that project on each side. Their head is furnished with a pair of large staring eyes, and surmounted by

* κεφαλή, cephale, *the head*; πούς, ποδὸς, pous, podos, *a foot—head-footed.*

conical fleshy tentacles, of various length in different species, but of great strength, capable of being bent in every direction, and, moreover, armed with suckers or adhesive disks, whereby they become firmly fixed to any object embraced in their snake-like folds. By means of these "*feet*," or tentacles, the animal is enabled to seize upon its prey, to walk, and even to swim. It swims backwards, and walks equally well in any direction, carrying its head close to the ground and its body upwards. The water taken in for the purpose of respiration is forcibly ejected through a fleshy funnel situated in the front of its neck. The mouth is situated in the centre of the circle of feet, and is furnished with two horny jaws, resembling in their shape the beak of a parrot. Within the mouth is a tongue, studded with horny spines, whereby the food is passed into the throat.

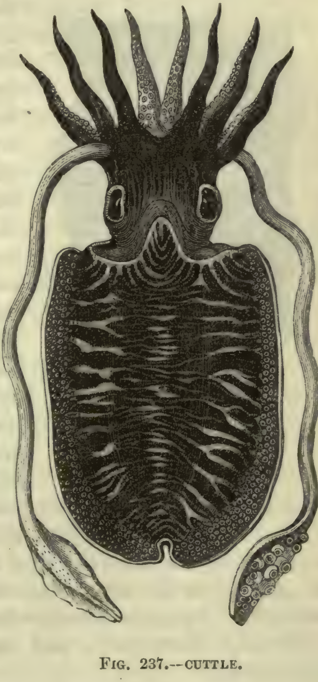


FIG. 237.--CUTTLE.

These animals are provided with a peculiar inky fluid of intense blackness, which they are able to eject in great abundance through the siphonal tube, thus darkening the surrounding water to a considerable distance; and their skin is endowed with a capability of changing its colour more remarkable than even that of the chameleon.

The Cephalopods are cruel and voracious, and from

their activity and the various means that they possess of seizing and of holding their prey, are exceedingly destructive to fishes and crustaceans around our coasts.

Their prehensile arms are, in the greater number of species, provided with suckers, called "Acetabula," that act like cupping-glasses. The mechanism for producing adhesion by means of these wonderful organs is extremely curious. From the margin of each cup muscular fibres converge towards the centre, at a short distance from which they leave a circular aperture; behind this is a false floor that can be raised, like the piston of a syringe, and thus produce a complete vacuum within the cup. So perfect is this mechanism that, while the piston continues raised, it is easier to tear away the sucker from the arm than to release its hold, but as soon as the muscular effort raising the piston ceases, the vacuum produced by its retraction is in an instant destroyed, and all the suckers detach themselves.*

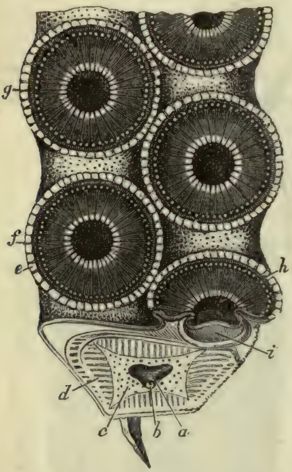


Fig. 238.—STRUCTURE OF SUCKERS OF CUTTLE-FISH.

Few spectacles are more wonderful than that pre-

* The tenacity of the gripe of the Cephalopod was fully appreciated by Homer, but the beauty of his simile has been but little understood by his translators:—

"As when the Cuttle-fish enforced forsakes
His rough abode, with his adhesive cups
He gripes the pebbles still;
So he, Ulysses, with his lacerated grasp,
The crumbled stone retained, when from his hold
The huge wave forced him, and he sank again."

HOMER'S ODYSS. BOOK V.

sented by these animals, while alive and free in their native element; changing their colours with the rapidity of thought, they dart from place to place with amazing activity; some species, indeed, cleave the water with such rapidity that the eye can scarcely follow their movements. Sometimes they swim by means of vigorous flappings of their arms, which are webbed like the feet of swans. Sometimes they employ their fleshy fins, or else propel themselves backward by forcible and repeated ejaculations of water through the tube or siphon placed in front of their bodies.

Several instances are on record of the occurrence of Cephalopods of enormous size. Aristotle speaks of a great Cuttle-fish five fathoms in length. Peron found in the sea near Tasmania a specimen, the arms of which measured 6 or 7 inches in diameter. Quoy and Gaymard collected in the Atlantic, near the equator, fragments of an enormous mollusk perhaps of the same kind, whose weight was estimated at 200 lbs. A Cuttle-fish was cast upon the shores of Jutland in 1853, the body of which was cut up by the fishermen for bait, and furnished loads for several wheel-barrows; a portion of one of the arms was as thick as a man's thigh. Fragmentary tentacles of large proportions are preserved in the Museum of the Royal College of Surgeons, and in that of King's College, in London.

A specimen of gigantic dimensions recently seen by the crew of a French man-of-war, escaped capture only by leaving a part of his tail behind him. "On the 30th November, 1861, the French steamer 'Alecton' being then about 40 leagues, N.E., off Teneriffe, fell in with a gigantic Cuttle-fish, of a brick-red colour, disporting himself at the surface of the sea. He was hit by several bullets, and at last struck with a harpoon and seized by a cord with a slip knot. At this moment, however, when every preparation was being made to secure it, the animal by a violent effort tore away the harpoon from its soft flesh, and at the same time the noose slipped down to its caudal

end where it held, but in hoisting the creature out of the water, the part thus seized broke off, and only a fragment, weighing about 46 lbs., was brought on board. Both sailors and officers were anxious to have a boat lowered in order to go in pursuit of the creature; but the captain, fearing that some harm might happen to the boat's crew in their struggle with so novel an opponent, declined, and left the mutilated Cuttle-fish to its fate. The ship was brought sufficiently near to enable one of the officers to make a drawing of it. Its length was 15 or 18 feet, and its eight arms, covered with suckers, were estimated at 5 or 6 feet long, its beak measured about a foot and a half across, and its weight was estimated

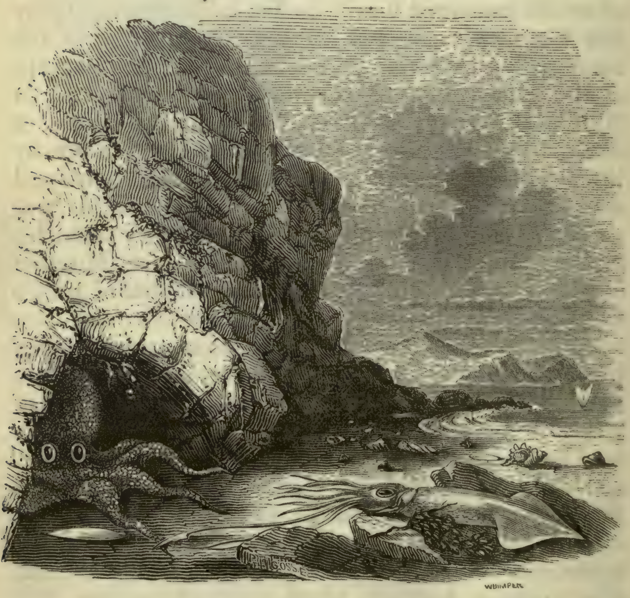


FIG. 239.—POULPE AND SQUID.

at 2,000 kilogrammes (above 4,000 lbs.)."—*Comptes Rendus*, 30th December, 1861.

The **Common Poulpe** (*Octopus vulgaris*), represented in Fig. 239, will serve to illustrate the general structure and habits of the class. A single glance at our engraving, representing one of these animals ensconced in the entrance of his den, is sufficient to convince us of the very unamiable character of such a monster. The giants and ogres of romance were never so fearfully armed, or clothed by the wildest fiction with so terrible an aspect. Eminently carnivorous, voracious, and fierce, these animals feed largely upon fishes, whose activity and slippery mail would elude a less effective apparatus than is here provided for their destruction. Beneath the staring eyes that indicate the creature's head, are spread eight strong and fleshy arms, united at their bases by a broad muscular expansion, and furnished upon their under surface with a hundred and twenty pairs of powerful and tenacious suckers, each of which might be compared to an air-pump in its efficiency and mode of action. No sooner does the Cuttle-fish, by throwing out its long flexible arms, bring but a few of its two thousand suckers in contact with the surface of its victim, than they adhere with unrelenting pertinacity, and the arms are swiftly twined around the struggling prey, which vainly strives to disengage itself from so fearful and so fatal an embrace. Their quickness of sight and the facility with which they detach their suckers is wonderful. Mr. Broderip attempted with a hand-net to catch an Octopus floating by with its long flexible arms entwined round a fish that it was tearing with its sharp bill. It allowed the net to approach within a short distance before relinquishing its prey; when in an instant it relaxed its thousand suckers, exploded its inky ammunition, and rapidly retreated under cover of the cloud thus occasioned, by rapid and vigorous strokes of its circular web. These cuttle-fishes also escape detection by a very extraordinary chameleon-like power of changing colour. They appear to vary their tints according to the nature of

the ground over which they pass. When in deep water their general shade is brownish purple; but when placed on land or in shallow water, this dark tint changes to one of yellowish green. The colour, examined more generally, is a French grey, with numerous minute spots of bright yellow. The former of these varies in intensity, the latter entirely disappears and appears again by turns. These changes are effected in such a manner, that clouds varying in tint between a hyacinth-red and a chestnut-brown are continually passing over the body.

"I was much amused by the various arts to escape detection used by one individual, which seemed fully aware that I was watching it. Remaining for a time motionless, it would then stealthily advance for an inch or two, like a cat after a mouse, sometimes changing its colour; it thus proceeded till having gained a deeper part, it darted away, leaving a dusky train of ink to hide the hole into which it had crawled."—DARWIN, *Voyage of the 'Beagle.'*

The **Calamaries** (*Loligo*). In the Octopus above described the arms or tentacles are only eight in number, and all nearly of equal dimensions; but in the Calamaries their number is increased to ten, the additional pair being lengthened into slender cables, at the end of which suckers are grouped together upon flat disks, and thus serve the purpose of anchors whereby the animal attaches itself to the rocks, and rides securely in a tempestuous sea. The general form of the body is comparatively slender, and towards the hinder extremity is provided with a pair of broad triangular fins, wherewith it is enabled to shoot through the water like an arrow. Imbedded in the fleshy substance of the back is a long transparent plate of horn, which in shape bears some resemblance to a pen; it is to the presence of this curious support that these animals are indebted for their name (*Calamus*, a pen); they are likewise called "pen-fishes."

The **Squids** (*Loligo piscatorum*), or as they are

called by our fishermen, "sleeves," or "hose-fish," are of great value as a bait. With these cuttles, indeed, one half of all the cod taken at Newfoundland is caught. They occur in vast numbers, at different times on different coasts, and their large shoals present a curious appearance. When they approach, hundreds of vessels are ready for their capture. At some seasons as many as 400 to 500 sail of English and French ships are engaged in the Cuttle-fish fishery. During violent gales, hundreds of tons are often thrown up together in beds on the flat beaches, the decay of which spreads an intolerable effluvium around. They are only used for bait, and instead of nets being employed for their capture, they are "jigged" by means of an instrument composed of a number of hooks made for the purpose. The cod is in best condition after having fed on the Squids. Calamaries are very prolific; their eggs are deposited in the form of numerous lengthened bands, radiating from a common centre, and spreading every way into a circular form: each egg is of a glassy transparency, and the young animal may be very distinctly observed in each many days before the period of their exclusion. These groups of eggs are often seen floating on the surface of the sea, and are occasionally thrown on shore. The whole group sometimes measures more than a foot in diameter, and from its general appearance might easily be mistaken for a large jelly-fish.

The **Hooked Squids** (*Onychoteuthis*) in their general form and structure resemble the Calamaries; but the suckers, which arm the expanded disks at the end of their long cable-like arms, are each of them provided with a strong and sharp hook, composed of horny substance, that projects backwards, and materially increases the tenacity of their grasp.

The **Cuttle-fishes**, properly so called (*Sepia*), in addition to the sucker-bearing arms of the Poulpe, are furnished with the long rope-like appendages of the Calamary. The shape of the Cuttle is round and

robust, and its body is furnished with a fleshy fin running along the entire length of each side.

The **Common Cuttle** (*Sepia officinalis*), numerous on our coasts, is about a foot in length. The colour is a dirty white, but if examined when alive there may be observed a sort of net-work of lines of a reddish or purplish hue playing over the surface, the markings continually changing their form and position, so as to cause a great variety of tints to play over the body of the animal, something like the flickering of a lambent flame. The changes of colour thus produced are quite wonderful. "Although common," says Mr. Darwin, "in the pools of water left by the returning tide, these animals are not easily caught. By means of their long arms and suckers they can drag their bodies into very narrow crevices, and when thus fixed, it requires great force to remove them. At other times they dart, tail first, with the rapidity of an arrow, from one side of the pool to the other, at the same instant discolouring the water with a dark chestnut-brown ink.

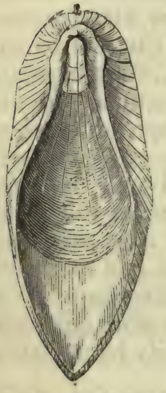


Fig. 240.—CUTTLE-SHELL.

The shell of the Cuttle-fish, or Cuttle-bone as it is generally called (Fig. 240), is a very curious structure. During life it is enclosed in a cavity of the mantle, wherein it lies quite loose and unattached: it is of an oval shape, and so light and buoyant as to constitute a most elegant float, that doubtless materially facilitates the movements of this otherwise unwieldy animal.

Like all the other naked Cephalopods, the Cuttle is remarkable for the power of ejecting, in large quantities, a black and inky fluid; this is contained in a bag, variously situated in different species, and can be spouted out at the will of the animal in surprising abundance, diffusing an impenetrable cloud that ex-

tends to a distance of many feet. Under the concealment thus obtained, the Cuttle-fish darts away from his foes, like one of Homer's heroes, protected by the interposition of a favouring cloud. This ink, dried and prepared, is the "sepia" employed by artists.

The eggs of the Sepia are frequently seen on the sea-beach. They bear no small resemblance to a bunch of grapes, being accumulated in clusters, adhering to each other by slender foot-stalks; they are, moreover, very nearly of the size and colour of that fruit (Fig. 241).

FIG. 241.—CUTTLE-FISH AND EGGS.

About the shores of the Eastern Mediterranean, the common Sepia officinalis is so abundant that the Cuttle-bones may be seen heaped by the waves into a ridge that fringes the coast for miles. "As in ancient times," says Professor Forbes, "these Mollusks still constitute a valuable part of the food of the poor, by whom they are mostly used. One of the most striking spectacles at night, on the coast of the Egean, is to see the numerous torches glancing along the shores, and reflected by the still and clear sea, borne by poor fishermen paddling as silently as

possible over the rocky shallows in search of Cuttle-fish, which, when seen lying beneath the water in wait for his prey, they dexterously spear, ere the creature has time to dart with the rapidity of an arrow from the weapon about to transfix his soft but firm body."

The **Argonaut** (*Argonauta*). The animal of the Argonaut is, in all respects, a Poulpe, the arms of which are furnished with two rows of suckers; but the hinder pair, those nearest the back of the animal, are expanded into a broad membrane. The most

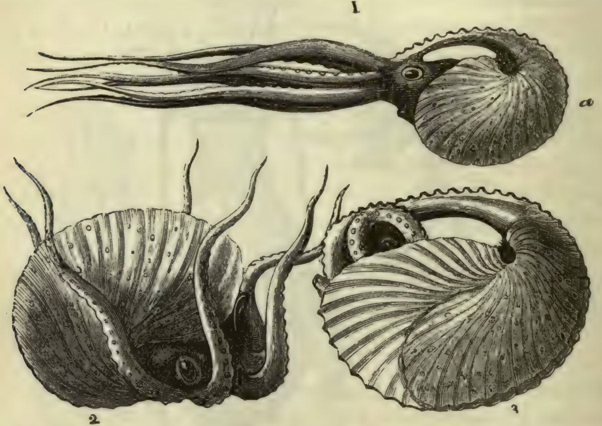


FIG. 242.—THE PAPER NAUTILUS (*Argonauta Argo*). *Fig.* 1, Swimming towards the point *a*; 2, walking on the bottom; 3, contracted within its shell, which is partly embraced by the arms.

remarkable feature in their economy, however, is that they reside in a thin calcareous shell, symmetrically channelled and spirally twisted at one extremity, but having the last whorl of the spire so capacious that it resembles a beautiful boat.

It was, indeed, to this Cephalopod that the ancients assigned the honour of having first suggested to mankind the possibility of traversing the sea in ships; and nothing could be more elegant than the frail bark in which the Argonaut was supposed to skim over the waves, hoisting sails to the breeze, and steering its

course by the assistance of oars provided for the purpose. It is almost a thankless office to dispel so pretty a fiction: modern researches, however, serve to show that its sailing capabilities have been much exaggerated. The Argonaut can certainly raise itself from the bottom and sport about at the surface of the water; but this is simply effected by the ordinary means used by Calamaries and Cephalopods in general, namely, by admitting the sea-water into its body, and then ejecting it in forcible streams from its funnel, so as to produce a retrograde motion, which is sometimes very rapid. Its usual movements are, however, confined to crawling at the bottom with its head downwards, and in this way it creeps, carrying its shell upon its back, as represented in our Figure.

The **Nautilus** (*Nautilus Pompilius*). Perhaps the

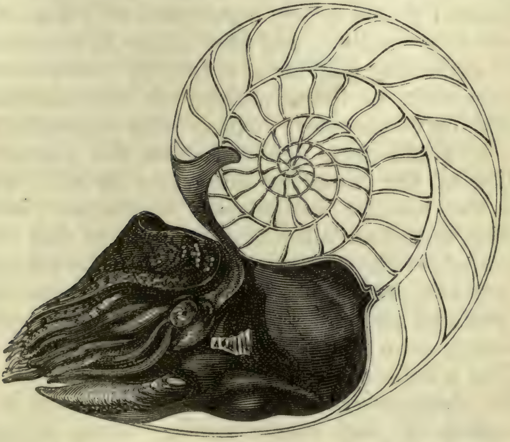


FIG. 243.—PEARLY NAUTILUS (*with the shell in section*).

most remarkable of all the Cephalopods is the *Nautilus*, the inhabitant of a chambered shell, which is sufficiently common—

> "A shell of ample range, and light
> As the pearly car of Amphitrite
> Which sportive dolphins drew."

Externally, this shell presents nothing remarkable except the elegance of its shape; but on making a section of it, as represented in Fig. 243, its cavity is found to be partitioned off, by numerous shelly plates, into various chambers, in the last and largest of which the body of the animal is lodged. A long tube, or *siphuncle*, partly calcareous, partly membranous, passes through all the compartments quite to the end of the series. This membranous siphuncle is continued into the animal, and terminates in a cavity contained within its body, which is in free communication with the exterior.

Various conjectures have been indulged in relative to the end answered by this chambered condition of the shell. It has been suggested that the chambers might be filled with air generated by the Nautilus, and thus made so buoyant, that the specific gravity of the animal should nearly correspond with that of the surrounding medium, and that acting in the manner of the swimming bladder of a fish, the creature would float or sink, as the contained air was alternately rarefied or compressed. Should this supposition be true, it would seem probable that the simple retraction of the muscular head into its shell would cause the needful compression of the air in this singular float, and allow the Nautilus to sink to the bottom, while the protrusion of its arms, by taking off the pressure, and thus allowing of the expansion of the confined air, would give every needful degree of buoyancy, even sufficient to permit the mollusk to rise like a balloon to the top of the sea.

The characteristic feature in the Nautilus is the conversion of the sucker-bearing arms of other Cephalopods into an apparatus of sensitive tentacula, quite destitute of suckers. Its gills or branchiæ are four in number instead of two, the head is covered with a strong leathery hood, which, when the animal retires into its shell, closes the orifice like a door. In place of the eight sucker-bearing arms of the Poulpe, there are forty tentacular appendages, which

can be protruded or retracted at pleasure, and the mouth is surrounded with a series of tentacles still more numerous. The Nautilus is, moreover, unprovided with an ink-bag; its beak is thick, and of stony hardness, apparently adapted to crush shells or corals, which most probably constitute its ordinary food.

The Nautili are not found in any great depth of water, but principally inhabit the reefs near which their food is most abundant. They creep about these reefs, with their shell uppermost, like a snail, and devour crabs and other crustaceans that come in their way, or they return and remain in a chasm of the rock, with their numerous tentacles spread out in all directions, waiting for prey to approach near enough to be captured. The feelers are very numerous, and evidently endowed with a keen sense of touch, but are quite destitute of the sucking disks so remarkable in the Cuttle-fish. When at the surface of the water, the Nautilus Pompilius drifts with the current or breeze; its navigation is passive, or at most influenced by the jets of water expelled occasionally through the funnel. The natives of the New Hebrides, New Caledonia, and the Fidgi groups of islands capture it and use it as an article of food. When the water is smooth, so that the bottom at several fathoms of depth can be distinctly seen, the fisherman in his canoe scrutinizes the sands and the coral rocks to discover the animal in its favourite haunts.

CHAPTER XXI.

VERTEBRATA.

THE fifth division of the Animal Creation is composed of four great classes, closely allied to each other in the grand features of their organization, and possessing in common a general type of structure, clearly recognizable in every member of the ex-

tensive series, although, of course, modified in accordance with the endless diversity of circumstances under which particular races are destined to exist.

The immeasurable realms of the ocean, the rivers, the lakes and streams, the fens and marshy places of the earth, the frozen precincts of the poles, and the torrid regions of the equator, have all appropriate occupants, more favoured as regards their capacity for enjoyment, and more largely endowed with strength and intelligence than any which have hitherto occupied our attention, and gradually rising higher and higher in their attributes until they conduct us at last to Man himself.

Fishes, restricted by their mode of respiration to an aquatic life, are connected, through amphibious beings that present almost imperceptible gradations of development, with terrestrial and air-breathing **Reptiles**; these, progressively endowed with greater perfection of structure and increased powers, slowly conduct us to the active and hot-blooded **Birds**, fitted by their strength and by the vigour of their movements to an aërial existence. From the feathered tribes of vertebrata, the transition to the still more intelligent and highly-endowed **Mammalia** is effected with equal facility, so that the zoologist finds, to his astonishment, that, throughout this division of animated nature, composed of creatures widely differing among themselves in form and habits, a series of beings unbroken as regards the physical organization, is distinctly traceable.

The first grand character that distinguishes the vertebrate classes, is the possession of an internal jointed skeleton, which is endowed with vitality, nourished by blood-vessels, capable of growth, and which undergoes a perpetual renovation by the removal and replacement of the substances that enter into its composition.

In the lowest tribes of vertebrata, the texture of the internal framework of the body is permanently cartilaginous, and it continues through life in a flexi-

ble and consequently feeble condition; but as greater strength becomes needful, in order to sustain more active and forcible movements, earthy particles are deposited in the interstices of the cartilaginous substance, and as these accumulate, additional firmness is bestowed upon the skeleton, until it becomes converted into perfect bone.

The complete skeleton of a vertebrate animal may be considered as being composed of several sets of bones, employed for different purposes, consisting of a central portion, the basis and support of the rest, and of various appendages derived from or connected with the central part. The centre of the whole osseous fabric is generally made up of a series of distinct pieces arranged along the axis of the body; and this part of the skeleton is invariably present; but the superadded appendages being employed in different animals, for very various and distinct purposes, present the greatest diversity of form, and are many of them wanting in any given genus, so that a really complete skeleton, that is a skeleton made up of all the pieces which might enter into its composition, does not exist, inasmuch as it is owing to the deficiency of some portions, and the development of others in particular races, that we must ascribe all the endless diversity of form and mechanism so conspicuously met with in this great division of the animal world.

The nervous system of the vertebrata consists of *the brain* contained within the cavity of the skull, continued from which, and lodged in a canal formed by the back-bone, is the *spinal marrow* or *spinal cord*, whence are derived, at intervals, symmetrical pairs of nerves, which escape from the spinal canal by appropriate orifices, situated between the different bones of the vertebral column, and are distributed to the voluntary muscles, and to the integument of the two sides of the body, thus constituting the medium whereby the intimations of the will are communicated to every part, and information received from the external world. The nervous system may thus be compared to an

electric telegraph, of which the brain is the central office, and the nerves the wires, along which travel with inconceivable rapidity the various commands and reports from all parts of the complex system.

With the increased development of the nervous system in the vertebrate classes, the organs of the senses assume a proportionate perfection of structure. The eyes, now invariably two in number, are lodged in cavities formed for their reception in the bony framework of the face. The auditory apparatus, of which only rudiments exist in the lower animals, gradually becomes more and more completely developed. Organs of smell of variable construction are generally present. The tongue becomes slowly adapted to appreciate and discriminate savours, and the sense of touch is especially conferred upon organs of different kinds peculiarly fitted to exercise the faculty. Thus, with increased intelligence, higher capabilities of enjoyment are allotted, and sagacity develops itself in proportion as the nervous centres expand.

The blood of all the vertebrata is red, and contains microscopic corpuscles of variable form and dimensions in different animals. In the class of fishes, owing to the as yet imperfect condition of the respiratory apparatus, the temperature of the body is scarcely higher than that of the surrounding medium; and even in reptiles such is the languid condition of the circulation, and the incomplete manner in which the blood is exposed to the renovating influence of oxygen, that the standard of animal heat is still extremely low; but in the higher classes, the birds and mammals, the effect of respiration is increased to the utmost, and pure arterial blood being thus abundantly distributed to all parts, heat is more rapidly generated, the warmth of the body becomes considerably increased, and such animals are permanently maintained at a higher temperature than that of the medium in which they live. Hence, the distinction generally made between the hot-blooded and the cold-blooded vertebrata.

The variations in the temperature of the blood above alluded to are, moreover, the cause of other important differences, observable in the clothing, habits and instincts of these creatures.

To retain a high degree of animal heat necessarily requires a warm and thick covering of some non-conducting material, and consequently in the hair, wool, and feathers of the warm-blooded tribes, we at once recognise the provision made by Nature for preventing an undue expenditure of the vital warmth. Such investments would be but ill-adapted to the inhabitants of a watery medium; and consequently the fishes, destined to an aquatic life, or the amphibious reptile, doomed to frequent the mud and slime of the marsh, are deprived of such incumbrances, and clothed in a scaly or slippery covering, more fitted to their habits, and equally in accordance with the diminished temperature of their blood.

Still more remarkable is the effect of mere exaltation of animal heat upon the instincts and affections of the different races of the vertebrata. The cold-blooded fishes, absolutely unable to assist in the maturation of their progeny, are content to cast their spawn into the water, and remain utterly careless of the offspring to be derived from it. The chilly reptile, nearly as incapable of appreciating the pleasures connected with maternal care, is instructed to leave her eggs exposed to the genial warmth of the sun, until the included young escape. But no sooner does the vital heat of the parent become sufficient for the purposes designed by Nature, than all the sympathies of parental fondness become developed, all the delights connected with paternity and maternity are superadded to other enjoyments; and the bird, as she patiently performs the business of incubation, or tenderly watches over her newly-hatched brood, derives a pleasure from the performance of the duties imposed upon her, second only to that enjoyed by the mammiferous mother, who from her own breast supplies the nutriment prepared for the support of her infant progeny.

CHAPTER XXII.

First Class of Vertebrata.

Fishes.

More than two-thirds of the surface of our globe is covered by the sea: continents and islands are everywhere intersected by rivers, and overspread with lakes and ponds, thus presenting an aggregate of waters so considerable as far to exceed the dry land in extent, and affording space for the existence of animated beings, by no means inferior, in number or variety of species, to those which inhabit the earth.

At first sight, we might suppose that the watery element afforded little diversity, and that the various races of fishes could as well inhabit one locality as another. The sea, however, in different latitudes offers great differences of temperature, especially in the vicinity of coasts, some of which, exposed to the full influence of a burning sun, reflect intolerable heat, whilst others, covered with snow, regions of ice and frost, exhibit a perpetual winter. Vast lakes are raised to considerable elevations, and from their glacier-barred sides the rivers stream with icy coldness. The rivers and the lakes are all fresh water, light and pure; the seas are salt, and thus of greater density; some waters are clear and limpid, others are agitated by continual currents, whirled in cascades, or hurried on in ceaseless torrents: the crystal fountain, and the muddy marsh, and all the shades of difference between these extremes, present so many climates, all of which require creatures of different habits and endowed with different faculties. We need, therefore, be no longer astonished at the infinite variety in the forms and endowments of the finny tribes, or surprised that some of them are of shapes that to our ignorance appear monstrous and

deformed, while others are very paragons of elegance and beauty. Many fishes, indeed, are adorned by the hand of Nature with every kind of embellishment—variety in their forms, elegance in their proportions, diversity and vivacity in their colours; nothing is wanting to attract the attention of mankind. The splendour of every metal, the blaze of every gem, glitter upon their surface; iridescent colours, breaking and reflecting in bands, in spots, in angles, or in undulating lines always regular or symmetrical, graduating or contrasting with admirable effect and harmony, flash over their sides: for whom have they received such gifts, they who at most can barely perceive each other in the twilight of the deep, and even if they could see distinctly, what species of pleasure can they derive from such combinations?

The teeth of fishes are very numerous, and are attached to almost every one of the bones that enter into the composition of the mouth. They are generally simple spines, curved backwards; but innumerable modifications of structure occur. Thus the teeth of the deadly Shark are flat and lancet-like, the cutting edges being notched like a saw; the front teeth of the Flounder are compressed plates; some, as the Wrasse, have flat grinding teeth, and

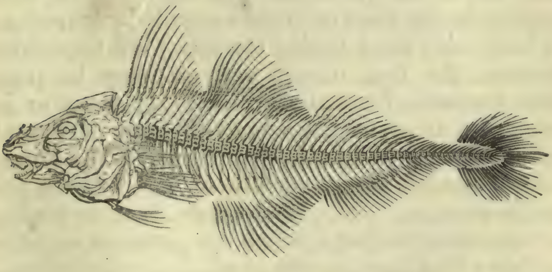


FIG. 244.—SKELETON OF HADDOCK.

others, as the genus Chrysophrys, have convex teeth, so numerous and so closely packed over a broad surface, as to resemble the paving-stones of a street.

The beautiful Chætodons of warm climates have teeth which resemble bristles, and these are set close together like the hairs of a brush; while the Perch of our own rivers has them still more slender, minute, and numerous, so as to resemble the pile of velvet. Another of our well-known fishes, the bold and fierce Pike, is armed with teeth scarcely less formidable in size, form, and sharpness than the canines of a carnivorous quadruped. In number, also, there is great variety. The Pike, the Perch, the Cat-fish, and many others, have their mouth crowded with innumerable teeth; the Carp and the Roach have only a few strong teeth in the throat, and a single flat one above, while the Sturgeon, the Pipefish, and the Sand-lance are entirely toothless.

The fins of fishes afford important characters whereby the different races are distinguished. Some of them are vertical, constituting a kind of keel and rudder. Those on the back are named *dorsals*, those behind the vent, and under the tail, *anals*, and at the extremity of the tail *caudal fins*. These differ in their number, size, and the nature of the rays that support them: sometimes they are spinous, and sometimes soft and jointed. The remainder of the fins are double, or form pairs, and represent the limbs of other classes of vertebrate animals. Those corresponding to the arms or wings are called *pectorals*, and are invariably fixed behind the gills; but those which represent the feet, named *ventrals*, may be placed either forwards, beneath the throat, or more or less backwards, as far as the commencement of the tail: both may differ in size, in the quality of the fin-rays, in their number and structure, or one or both pairs may be wanting. Eels, for example, have no ventrals. Murænæ have neither *ventrals* nor *pectorals*, and there are fishes that have no fins at all.

The food of fishes consists principally of animal matter. Those that inhabit fresh waters live upon worms, mollusks, the larvæ of water-insects, or such flies as play or alight upon the surface; others feed

on reptiles and small quadrupeds. The marine kinds often devour crustaceans, star-fishes, and mollusks, and some, both of fresh and salt waters, live on vegetables. But the great majority prey upon each other; the larger devouring the less, these devouring others inferior to them in size, and so on.

The armour in which most fishes are encased is well worthy of our admiration. In some species, as

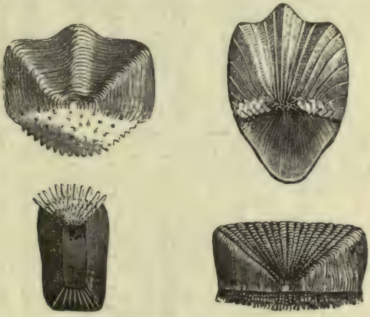


FIG. 245.—SCALES OF FISHES.

the Pipe-fishes and Sea-horses (*Syngnathidæ*) the body is covered with strong bony plates: these in the Trunk-fish (*Ostracion*) are so firmly soldered together as to form a box, through openings in which the tail and fins project. The skin of the Shark is covered with minute spines, felt to be rough and rasp-like, if the hand be gently passed over them from the tail towards the head, but are imperceptible if rubbed in the contrary direction. The most common form of a fish's covering, however, is that of separate scales, each imbedded in a fold of the skin on the margin next the head, and overlapping its successor with the opposite edge. These scales vary in their form, those from different parts of the body not being quite alike even in the same fish. The characters available for the classification of fishes are thus derivable from very various sources, as will be seen in the following tabular view of their arrangement, according to the system adopted by Cuvier:—

TABULAR ARRANGEMENT OF THE CLASS OF FISHES.

FISHES. Having their skeleton. Division of osseous fishes.	Bony: upper jaw complete. Upper jaw moveable	Branchiæ in the form of a comb.	Fin-rays bony in the anterior dorsal fin; sometimes the fin-rays of the anal fin are bony; and ordinarily there is one bony fin-ray in each ventral fin			**ACANTHOPTERYGII**	Perch, Mackerel, Tunny, &c.
			All the fin-rays soft, except sometimes the first one in the dorsal or pectoral fin . .	With ventral fin.	Situated behind the abdomen	**MALACOPTERYGII ABDOMINALES.**	Carp, Herring, Pike, Salmon.
					Suspended to the shoulder-belt . .	**MALACOPTERYGII SUB-BRACHIATI.**	Cod, Plaice, Turbot, &c.
				Without ventral fins . .		**MALACOPTERYGII APODES.**	Eels, &c.
		Branchiæ arranged in round tufts				**LOPHOBRANCHII** .	Sea-horse, &c.
	Upper jaw solidly fixed to the cranium					**PLECTOGNATHI.** . . .	Ostracion.
	Cartilaginous: Palatine bones in place of bones of the upper jaw .	Branchiæ free on their external edge—a single orifice for each operculum				**CHONDROPTERYGII** With Branchiæ free.	Sturgeons.
		Branchiæ adherent at both their edges: several branchial openings . . .			Lower jaw moveable . . .	**CHONDROPTERYGII** With Branchiæ fixed.	Sharks, Rays, &c.
Division of cartilaginous fishes					Jaws forming a circle . . .	**CYCLOSTOMI**	Lampreys, &c.

Order of Spiny-finned Fishes.

Acanthopterygii.*

In the *Spiny-finned fishes,* the first fin-rays of the back are always bony and spinous. When there are two dorsal fins, these spiny rays only exist in the front one, and when there is but one, they sustain at least its anterior portion, or sometimes are entirely free and separate. Generally there is also a bony ray to each ventral fin, and frequently the anal fin has some of its front rays spinous.

This order may be divided into several families, the most remarkable of which are the *Perches,* the *Mullets,* the *Gurnards,* the *Labyrinthiform Pharyngeals,* and the *Mackerels.*

The family of **Perches** (*Percoids,*† or fishes that resemble the Perch in their general structure) comprehends such as have an oblong, more or less, compressed body, covered with scales which are generally hard. The mouth is large, and armed with teeth upon all the prominent parts of its interior, and the gill-cover (*operculum*) is dentate or spiny on its edge ; the fins are always seven or eight in number. In general, they are adorned with beautiful colours, and their flesh is very agreeable food.

The **Perches** (*Perca*) are distinguished by their smooth tongue, and by the spines on their opercula. They inhabit fresh water. The common perch is found throughout Europe, and a great part of Asia. It inhabits lakes, rivers, and running streams, and ordinarily swims at a depth of two or three feet. Perches feed on worms, insects, and small fishes. They spawn in the month of April, and their eggs are joined together by a viscid matter in long cords, found interlaced among reeds, &c.

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* ἄκανθα, acantha, *a thorn or spine ;* πτερύγιον, pterygion, *a fin*—having fins with spinous or thorn-like rays.

† The families of fishes are frequently designated by adding the syllable *oid*—derived from the Greek word εἶδος (eidos), *form*—to the name of the typical species. Thus, *Percoid* means like the Perch ; *Gadoid,* like the Cod ; *Scomberoid,* like the Mackerel. &c. In the same way, the Greek patronymic *idæ* is frequently employed : thus we say, **Perca,** the *Perch ;* **Percidæ,** the family of Perches ; **Gadus,** the *Cod ;* **Gadidæ,** the family of Cod-fishes ; **Scomber,** the *Mackerel ;* **Scomberidæ,** the family of the Mackerels. In the following pages both these forms are used indiscriminately.

The **Sea Perch** or **Basse** (*Labrax*) closely resembles the river perch. The scales are large, of a metallic lustre, and the operculum is ser-

FIG. 246—THE PERCH.

rated upon its middle plate. This fish abounds on our southern coast, and is much esteemed as an article of food.

FIG. 247.—THE BASSE.

The **Mullets** (*Mullus*) are easily distinguished by the large scales with which the whole body is covered, and by two long *cirrhi*, or beards, that hang from under the lower jaw. Two species live in European seas, namely, the Red Mullet and the Surmullet.

The **Red Mullet** (*Mullus barbatus*) has the body and tail red, even after the scales have been removed; its size is ordinarily from eight to ten inches. It lives in many seas, particularly in the Mediterranean, and is much prized for the excellency of its flesh. It is

celebrated on account of the pleasure which the Romans took in contemplating the changes of colour it displays whilst dying. Exorbitant prices were paid for Mullets of extraordinary size, and at entertainments they were brought to table alive, and cooked before the eyes of the guests.

FIG. 248.—RED MULLET.

The **Surmullet** (*Mullus surmuletus*) is larger than the Mullet, and is longitudinally striped with yellow.

The family of the **Mailed-Cheeks** (*Buccæ Loricatæ*) is recognised by the manner in which the bones of the face are prolonged to the gill-covers, and protect the cheeks as with a bony case. In this family are placed

The **Flying-Gurnards** (*Dactylopterus*),* in which the pectoral fin-

FIG. 249.—ORIENTAL FLYING-GURNARD.

* δάκτυλος, dactylos, *a finger;* πτερόν, pteron, *a wing*—finger-winged.

rays are very numerous, and united by a membrane so as to form large pectoral fins, whereby these fishes are enabled to sustain themselves in the air when they spring out of the water in the hope of escaping from their enemies. Voyagers meet with them in the Mediterranean, but more frequently in tropical seas. They swim in numerous shoals, which the Bonito and other voracious fishes fiercely pursue; and when, to escape this danger, they spring into the air, another, not less great, awaits them, for a host of sea-birds. such as the Frigate-bird and Phaeton, are always ready to pounc upon them.

The **Squamipennes** * (*scaly fins*) are recognised by having the soft and sometimes the spinous part of the dorsal fin covered with scales, and scarcely distinguishable from the mass of the body. Their jaws are furnished with several rows of teeth, resembling in their conformation and arrangement the hairs of a brush. Their mouth is very small, and the dorsal and anal fins covered with scales. These fishes are numerous in the seas of hot climates, and are re-

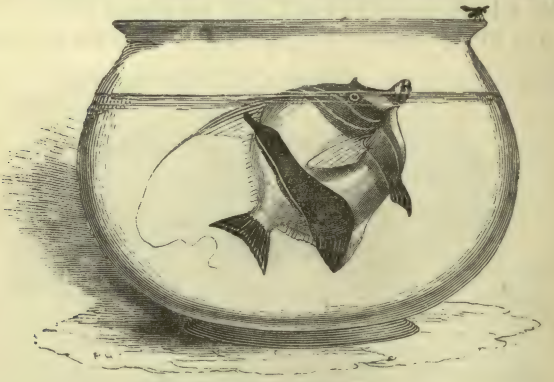

FIG. 250.—THE SHOOTING-FISH.

markable for the beauty and brilliancy of their colours. Among them may be mentioned a singular group, called

The **Archers**, or Shooting-fishes (*Toxotes*),† of which a common species, *Toxotes jaculator*, inhabits the Ganges and the seas of India.

* Squama, *a scale;* penna, *a feather or fin.*
† *τοξότης*, toxotes, *an archer.*

They are celebrated on account of the manner in which they are said to project drops of water at insects that frequent aquatic plants, in order to bring them down to feed on them. They can hit their game at the height of three or four feet, and rarely miss their aim.

The family of **Labyrinthiform Pharyngeals** is remarkable from its members possessing an apparatus of very complicated cells situated above the gills. These cells, enclosed beneath the operculum, and formed by convolutions of the bones of the throat, serve to retain a certain quantity of water, which keeps the branchiæ wet when the animal is exposed to the air, and thus enables it to live for a considerable time out of the water. Some species are in the habit of leaving the rivers and pools, their usual abode, and going to considerable distances, crawling on the grass or on the land. Those that possess the labyrinthiform arrangement in its highest degree of complication (*Anabas*, *Perca scandens*), not only remain a long time out of the water, but also, as we are told, climb trees. Most of the fishes of this family inhabit India and China.

The family of **Mackerels** (*Scomberoids*) is the most important of the order. It comprises many fishes of considerable size, the flesh of which is excellent, and their fecundity so inexhaustible, that in spite of the continued destruction to which they are subject, they return yearly in immense legions to the same localities, and offer themselves a rich reward to the activity of fishermen and the industry of those who make it a business to prepare and preserve them. In general, the *Scomberoids* have very small scales, and a large part of their skin is smooth. They have no spines nor denticulations upon the opercular bones; their vertical fins are not scaly; the tail and the caudal fin are large and very vigorous. Most of them have the sides of the tail armed with broad shield-like plates; and, in many, the posterior rays of the second dorsal and anal fins are separated into distinct portions, and form so many false or spurious fins.

Those which possess these last characters, and have the dorsal fin continuous, form the family of

Mackerels (*Scomber*), including the Tunny, the Sword-fish, the Bonito, and the Common Mackerel.

The **Common Mackerel** (*Scomber scombrus*) has a blue back marked with undulating black stripes, and five false fins; it is a migratory fish, and at certain seasons abounds both on the coasts of Europe and of America. On the western coast of England mackerel are captured with nets by torchlight. The fishermen spread them-

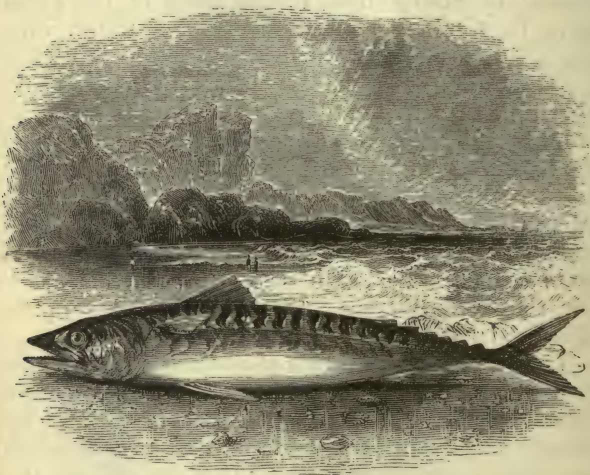

FIG. 251.—THE MACKEREL.

selves over several miles, and cast their nets, which are sometimes more than a league in extent, in the direction pursued by the shoals of Mackerel. The meshes of the net are of a size to receive the head of a moderate-sized fish, but arrest it by the fins, and when it endeavours to extricate itself its gills become entangled, and it is held prisoner.

The mackerel is also caught by the hook and line. It bites voraciously at anything that appears to have life — a bright fish, a piece of glittering metal, or a bit of scarlet cloth. The line is short, but made heavy with lead, and in this manner a couple of men can catch a thousand in a day. With swelling sails the boat flies along, and a sharp wind is considered so desirable that it is called a "Mackerel breeze." The more rapid the speed the greater the success, for the Mackerel rushes like lightning after the boat, taking it for a flying prey. "There is not," writes the author of 'Wild Sports of the West,' "on sea or river, always excepting angling for Salmon, any sport comparable to this delightful amusement, full of life and bustle, everything about it is animating and

exhilarating, a brisk breeze and a clear sky, the boat in quick and constant motion, all is calculated to interest and excite. He who has experienced the glorious sensation of sailing on the Western Ocean, a bright autumnal sky above, a deep-green swell around, a steady breeze, and as much of it as the hooker can stand up to, will estimate the enjoyment of a morning's mackerel-fishing."

The **Tunnies** (*Thynnus*) are closely related to the Mackerel, from which they are distinguished by a kind of corselet round the thorax, composed of scales larger and not so smooth as those of the rest of the body.

The **Common Tunny** (*Scomber Thynnus*) resembles the Mackerel in its general form, but is rounder, and attains a larger size. In general, its length is three or four feet, but it has been known to attain more than fifteen. This fish is sometimes seen in the ocean, but it abounds specially in the Mediterranean. At certain periods it coasts along the shore in innumerable shoals, and gives rise to very important fisheries, which have been carried on from time immemorial, and constitute a chief source of wealth to Provence and Sardinia. One of the most remarkable modes of taking the Tunny is by the *Madrague:* this name is given to a sort of labyrinth of nets stretched out vertically into the sea, and so arranged as to form a series of chambers. The fishes first pass between the shore and the chambers destined to receive them, but arrested by a cross net, they turn towards the high sea, and enter the labyrinth, where they become bewildered, and pass on into the last enclosure, called the "chamber of death" or "corpou." This compartment is provided with a

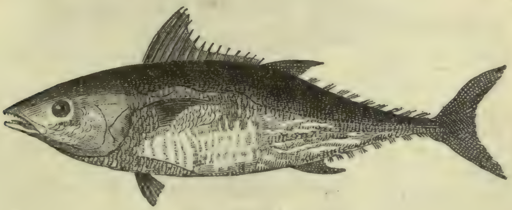

FIG 252.—TUNNY.

moveable floor formed of netting, which can be raised to the surface of the water by means of ropes, and as the moving floor of the corpou gradually rises, the Tunnies begin to appear, and soon the whole shoal is exposed to view. Pressed close to each other, the monster fishes throw themselves about and rush in despair against the netted walls of their prison. Animated by the sight of their victims, the fishermen assail them in a body, and the whole becomes a wild scene of massacre. The serried crowds of slaughterers seem to be composed of nothing but violently moving heads, bloody arms that rise and fall, and harpoons that flash and cross one another as

they are hurled at the helpless fishes. All eyes are sparkling, all lips are uttering cries of triumph, clamour, and encouragement, the waters are dyed red with blood, the dying lie heaped together in vast multitudes, and the result is that 500 or 600 Tunnies are thus butchered in one "tonnara." The flesh of the Tunny is much esteemed; it resembles beef, and is preserved either by the aid of salt, or by boiling and immersing it in oil.

The **Bonito** (*Scomber pelamys*), celebrated on account of its pursuit of the flying-fishes in the tropics, is a kind of Tunny—it may be

FIG. 253.—BONITO

recognized by the longitudinal brown stripes with which the belly is marked.

The **Sword Fishes** (*Xiphias*)* are distinguished by their beak, or sword-like nose, which is often fifteen feet in length. This fish is

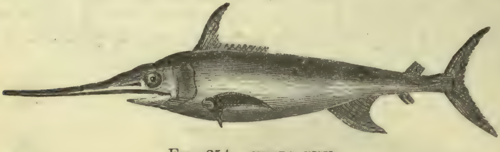

FIG. 254.—SWORD-FISH.

more common in the Mediterranean than in the Atlantic. The flesh, which is white and compact, is delicate. It is often taken with the harpoon.

Another tribe, called **Centronotus**,† is characterized by the absence of the membrane that unites the rays of the first dorsal fin, which consequently remain free. Among other fishes belonging to this tribe is

The **Pilot Fish** (*Naucrates*‡ or *Scomber ductor*), so called from its habit of following vessels to seize anything that may be thrown overboard, and also the habit attributed to it of conducting the Shark, which, directed by the same instinct, frequently accompanies vessels at sea with great perseverance. It has somewhat the

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* *ξίφος*, xiphos, *a sword.*

† *κέντρον*, centron, *a sharp point*; *νῶτος*, notos, *the back.*

‡ *ναυκράτης*, naucrates, *commanding the sea.*

appearance of a Mackerel, with a cartilaginous keel on the sides of the tail. The common species is about a foot long.

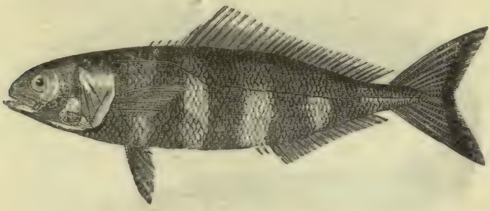

FIG. 255.—PILOT-FISH.

The **Dolphin Fish** (*Coryphæna*) must not be confounded with the true Dolphin (*Delphinus*), to be described hereafter. Nevertheless, the Coryphænæ are equally subjects of universal admiration.

During a calm these fishes, when swimming about a ship, appear of a brilliant blue or purple, shining with metallic lustre in every change of reflected light. On being captured and brought on deck, the variety of these tints is very beautiful; the bright purple and golden yellow hues change to a brilliant silver, varying back again into the original colours, purple and gold. This alternation of tints continues for some time, diminishing in intensity, and at last settles down to a dull leaden hue.

FIG 256.—CORYPHÆNA.

"Parting day
Dies like the Dolphin, whom each pang imbues
With a new colour, as it gasps away,
The last still loveliest, till,—'tis gone—and all is grey."

The **Riband Fishes** (*Tænioids*)* are distinguished by an extremely elongated body, very much flattened

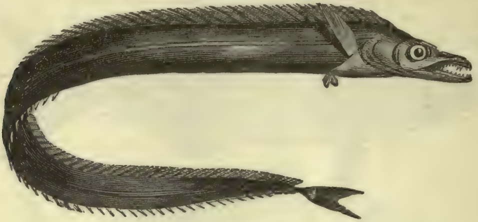

FIG. 257.—SCABBARD-FISH.

on the sides: their form has obtained for them the name of *Riband Fishes* and *Scabbard Fishes.*

The Family of **Mugiloids** is distinct from all the preceding, and is characterized by an almost cylindrical body covered with large scales, a slightly-depressed head, and short muzzle, a transverse mouth armed with extremely fine teeth, two separate dorsal fins, and the ventral fins attached behind the pectoral. They constitute a single genus,

The **Mullets** (*Mugil*) which, although they bear in English the

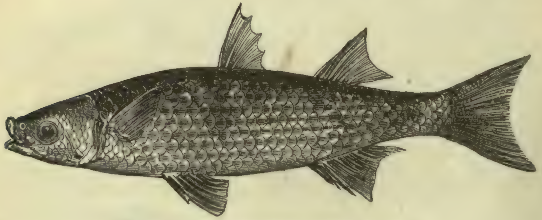

FIG. 258.—THICK-LIPPED GREY MULLET.

same name, must not be confounded with the *Red Mullet* (*Mullus*) described in a preceding page. Their flesh is much esteemed.

* *ταινία*, tænia, *a riband*; *εἶδος*, eidos, *form, shape.*

Order of Abdominal Soft-Finned Fishes.

Malacopterygii * Abdominales.

This division is composed of osseous fishes that have the upper jaw moveable: simple pectinate gills, and the fin-rays soft and flexible; their ventral fins are suspended behind the pectorals, as though they were attached to the abdomen, whence the name of the Order.

They may be divided as in the following Table:—

MALACOPTERYGII ABDOMINALES.	Without an adipose fin on the back	Margin of the upper jaw formed almost entirely by the upper maxillary bones	Mouth small and weak, often unprovided with teeth except around the pharynx. Body scaly	**CYPRINOIDS.** Carps.
			Mouth large and armed with strong pointed teeth. Body ordinarily covered with very small scales . .	**ESOCES.** Pikes.
		Margin of the upper jaw formed in the middle by the intermaxillary bones, and on the sides by the maxillary bones. Body scaly . . .		**CLUPEÆ.** Herrings.
	With an adipose fin on the back .	Body scaly		**SALMONIDÆ.** Salmons.
		Body unprovided with true scales		**SILUROIDS.** Sheat-fishes.

* μαλακός, malacos, *soft*; πτερύγιον, pterygion, *a fin*.

The **Carps** (*Cyprinus*). This group is characterized by the absence of teeth in the jaws, and by the existence of a long dorsal fin; ordinarily the scales are very large. Most of them feed upon grain and vegetable substances. They have in the back part of their mouth a remarkable apparatus for crushing their food.

The **Common Carp** (*Cyprinus carpio*) is found throughout Europe; it delights in tranquil waters, and is easily reared in rivers and

FIG. 259.—THE CARP.

ponds. The duration of its life is long, and it is exceedingly prolific. When young, its growth is very rapid, and at six years old it weighs about three pounds. During the winter Carps bury themselves in the mud, and pass many months without eating.

The **Golden Carp**, or *Gold-fish* (*Cyprinus auratus*), is reared in garden-ponds and vases on account of the beauty of its colours, generally a beautiful golden-red, with a mixture of black, and silvery-white.

The **Barbels** (*Barbus*) resemble the Carps, but their dorsal fin is

FIG. 260.—BARBEL.

shorter. The common Barbel (*Cyprinus barbus*) abounds in clear running waters.

The **Gudgeons** (*Gobis*) have no bony spine in the anterior part of the dorsal and anal fins; the mouth is surrounded with *cirrhi* or beards. Though small, they are much esteemed.

The **Tenches** (*Tinca*), in addition to the characters of the Gudgeons, have very small scales and very short cirrhi. The common Tench

FIG. 261.—TENCH.

(*Cyprinus tinca*) inhabits stagnant waters; it is generally of a yellowish-brown colour, and attains a foot in length; it is less esteemed than the Carp.

The **Breams** (*Abramus*) have neither spinous fin-rays nor cirrhi; their dorsal fins are short, but the anal is long.

The **Minnow** (*Cyprinus Phoxinus*)* is a very small fish, met with in every brook.

The **Roaches** (*Leuciscus*) form several species. The common Roach (*Leuciscus vulgaris*), attains seven or eight inches in length, and is remarkable for its brilliant scales, which are easily detached. The iridescent substance, which gives them this metallic appearance, is employed abroad for the manufacture of false pearls.

The **Pikes** (*Esox*) are recognised by their oblong, obtuse, broad, depressed muzzle; they have but one dorsal fin, which is placed opposite to the anal, and nearly the whole interior of the mouth is full of teeth as well as the jaws.

The **Common Pike** (*Esox lucius*) is met with in the fresh waters of Europe and North America, and is everywhere caught for its flesh, which is wholesome and easy of digestion. It is the most voracious and destructive of all fresh-water fishes; it devours, with avidity, frogs, young ducks, and all the fishes that come in its way. It often seizes animals larger than itself, and its presence in a pond is sometimes enough to depopulate it in a very short time. Pikes four or five feet long are not rare in the great lakes of Northern Europe, and one of still larger size has been seen. In 1497, a Pike was caught at Kaiserlauten, near Mannheim, which was nearly nineteen

* φοξός, phoxos, *pointed*.

feet in length, and weighed three hundred and fifty pounds. This monster was as remarkable for its great age as for its size, for there was found upon it a gilt copper ring, bearing this inscription—"I

FIG. 262.—THE PIKE.

was the first fish that was thrown into this pond by the hands of Frederick II., Oct. 5, 1230;" it was consequently at least two hundred and sixty-seven years old. The growth of these fish is very rapid; the first year they are often ten or eleven inches in length, and in the second fifteen.

The **Sea Pike** (*Esox belone*),* also known as the *Gar-fish*, *Spit-fish*, and *Bill-fish*, belongs to this family.

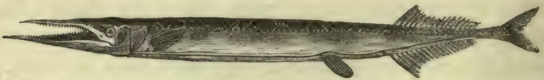

FIG. 263.—THE GAR-FISH.

The **Flying Fishes** (*Exocetus*)† belong to the same family as the Pikes, and are recognised, at first sight, by the excessive length of their pectoral fins, which are long enough to serve them as wings, and to sustain them for a few seconds in the air. They swim in shoals, and are pursued by legions of voracious enemies, to escape from which they spring out of the water, but soon fall again, because their wings only serve them as a parachute. While on their aërial course, they often become the prey of sea-birds. It is a beautiful

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* βελόνη, belone, *a needle or spear-head.*

† ἐκ, ek, *outside;* κοίτη, coite, *a bed,* so called because these fishes were supposed to sleep on land.

sight on a clear day to see them sparkling in the air, with silvery brightness, or rushing from the water with an audible rustling sound as they spread out their large pellucid wings or fins in a

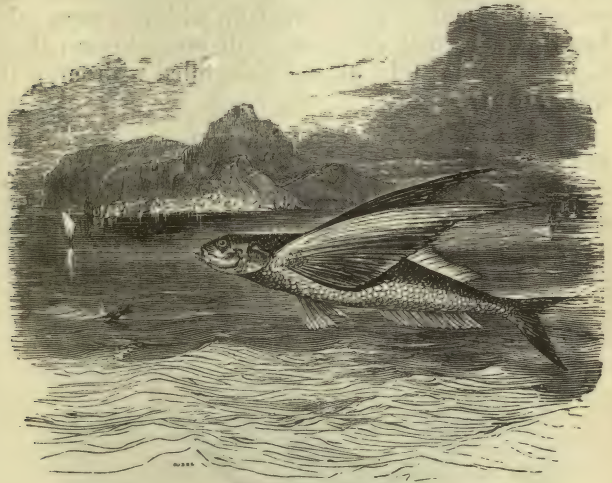

FIG. 26.—THE FLYING-FISH.

new element, their brilliant purple backs gleaming, and their sides blazing like molten metal, under the dazzling light of a tropical sun. The greatest length of time they remain in the air is thirty-two seconds, and their longest flight from 200 to 250 yards.

The **Siluroids** differ from all other abdominal Malacopterygians, in their want of true scales. The skin is naked, or furnished with bony plates. The dorsal and pectoral fins have a long articulated spine for the first fin-ray, and there is a small adipose, or soft fin, towards the hinder part of the back: one species,

The **Sheat Fish** (*Silurus glanis*), is the largest fresh-water fish in Europe; its length ordinarily exceeds six feet, and its weight is near three hundred pounds.

The **Electric Silurus** (*Silurus electricus*) of the Nile, like the Torpedo and Gymnotus, possesses the power of giving strong electric shocks.

The seat of this extraordinary faculty is in a peculiar tissue, situated between the muscles and the skin, and having the appearance of a fatty cellular structure. This fish, which inhabits the

Senegal as well as the Nile, is eighteen or twenty inches in length. The Arabs call it *raasch*, which signifies *thunder*.

The **Salmons** (*Salmonidæ*) are distinguished by a scaly body, and a first dorsal fin with soft rays, followed by a second which is small and adipose; that is, formed by a fold of the skin filled with fat, and without rays.

The **Common Salmon** (*Salmo Salar*) is the largest species of the family. It is found in great numbers in the Arctic Seas, whence it ascends rivers in large shoals every spring. It swims with great rapidity, and can clear at a leap obstacles to its passage twelve or fifteen feet in height. When salmon arrive at a place fit for spawning,

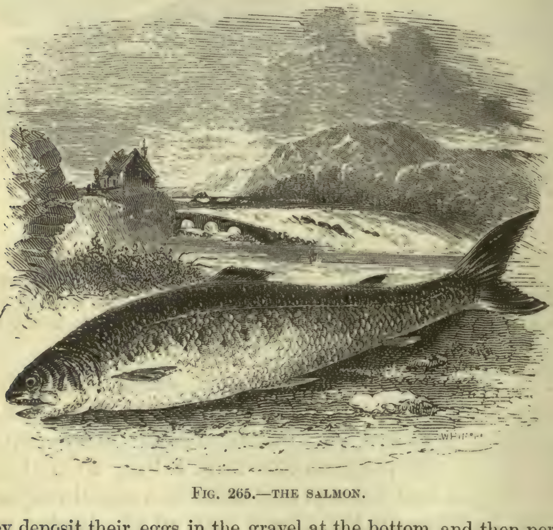

FIG. 265.—THE SALMON.

they deposit their eggs in the gravel at the bottom, and then permit themselves to be carried by the current to the sea; where they go to acquire strength and return again the following spring. Young Salmon are therefore born in the rivers: their growth is rapid, and when they attain the size of about twelve inches, they descend to the sea like the adults.

The Salmon-fishery, in many countries, forms a very important branch of industry. In Norway, as many as 300 of these fishes have been caught at one haul, and in the River Tweed as many as 700. The time selected for catching them is when they ascend the rivers to spawn, for after they have deposited their eggs, and are on their way to the sea, they are very lean and their flesh of little value.

In general, this fishery is conducted by means of nets, stretched across the river, and so arranged that the Salmon are caught in the meshes. But sometimes, in Scotland for example, they are speared with a many-pronged weapon called a *leister*. They are also caught with a rod and line.

The *Salmon Trout* (*Salmo trutta*), the *Common Trout* (*Salmo fario*), the *Smelts* (*Osmerus*), and the *Graylings* (*Thymellus*), all belong to this important family.

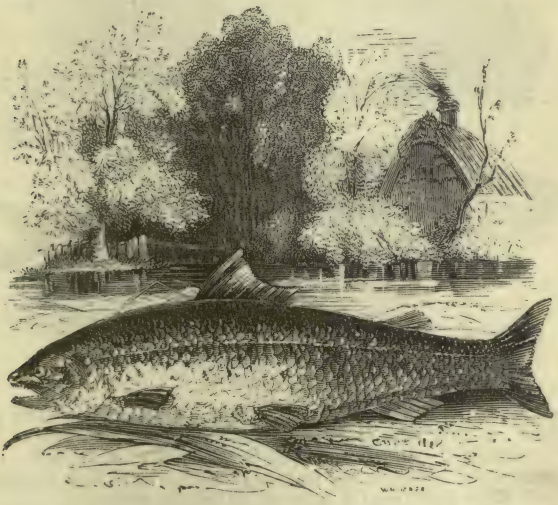

FIG. 266.—THE COMMON TROUT.

The **Herrings** (*Clupeadæ*) have no adipose fin. The upper jaw is formed in the middle by the inter-maxillary bones, and on the sides by the maxillary bones. Their body is always scaly.

The **Common Herrings** (*Clupea harengus*) inhabit the northern seas, and arrive every year upon different parts of the coasts of Europe, Asia, and America, but do not go very far south of the fortieth degree of north latitude. Some naturalists have supposed that all herrings periodically retire beneath the ice of the Polar Seas, and set out from this common retreat in an immense column, which dividing spreads along the coasts north of the parallel above named; but this distant emigration, and this northern rendezvous in the Arctic regions, are far from being demonstrated, and there is reason to believe that such is not the case.

In the months of April and May herrings begin to appear off the Shetland Islands, and towards the end of June, or in July, they arrive in incalculable numbers, forming vast and dense shoals, which sometimes extend over the surface of the sea for several leagues, and are hundreds of feet in thickness. The Herring-fishery is of great

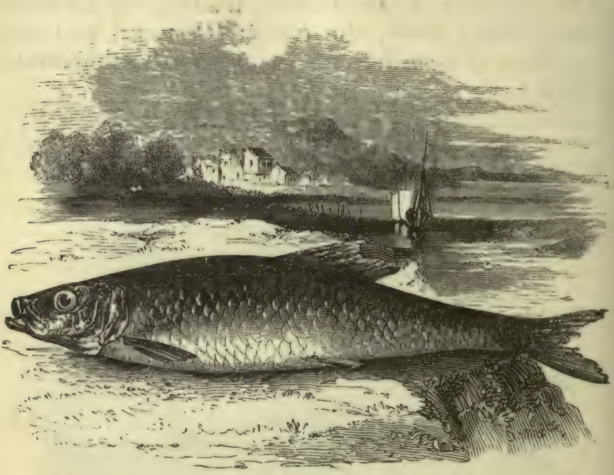

FIG. 267.—HERRING.

importance; it occupies every year entire fleets, and formerly was carried on with still greater activity. About the middle of the 17th century, the Dutch employed not less than 2,000 vessels; and it is estimated that 800,000 persons in Holland and West Friesland derived their living from this branch of industry alone.

Herrings are generally caught by means of nets, five or six hundred fathoms in length, the lower edge of which is loaded with lead, while the upper edge is made to float upon the surface, by means of buoys of cork. The meshes are just large enough to receive the head of a herring as far as the gills, but not to allow the pectoral fins to pass. The fish, in endeavouring to overcome the obstacle that this great vertical net opposes to its passage, is thus *meshed*, and not being able to advance or to recede, owing to the gills and the fins, he remains a prisoner until the fishermen draw the net on board. This is termed a *gill-net*. The number of herrings taken in this way is sometimes so great that the net bursts under their weight. Generally, this fishery is carried on at some distance from the shore, and the herrings are salted on board.

The **Sardine** (*Clupea Sardina*) is a small species of Herring, celebrated for the delicacy of its flesh. It inhabits the Baltic, the Atlantic, and the Mediterranean. During the winter, it keeps in the depths of the sea, but about the month of June, it draws near the shore in immense shoals. As many as forty or even fifty thousand

have been taken at a single cast of the net. Sardines are caught in the same way as Herrings, but the meshes of the net are smaller, and the fishermen, to attract the fish, throw into the sea a peculiar bait, formed from Cod-fish eggs. From the mouth of the Loire to the extremity of Brittany, Sardines abound every summer, and give rise to productive fisheries. Along the coast there are a great number of establishments for the preparation and preservation of these delicate luxuries.

The *Pilchard*, the *Sprat*, the *White Bait*, and the *Shad*, are all of them species of Herrings.

The **Anchovies**, too (*Engraulis*), belong to this family, but they differ from the herrings in the mouth, which is cleft to far behind the eyes, in their gills, which are more open, and in some other characters.

The **Common Anchovy** is found in the Mediterranean as well as on the western coasts of France and Spain. At a certain time of the year, which varies in different localities, it leaves the high seas and approaches the coast to spawn, when it becomes the object of an important fishery; to catch it the fishermen provide themselves

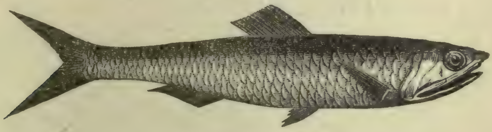

FIG. 268.—ANCHOVY.

with nets, about two hundred feet in length, and twenty-five or thirty in breadth, and assemble four boats, one of which carries the net, and the others furnaces in which they make a bright fire. This fishery is carried on in the dark nights from April to July. The boats are stationed about five miles from the coast, and when the Anchovies, attracted by the light, are assembled in large numbers around a boat thus illuminated, the net is cast into the water, and laid out so as to surround the assembled fishes. This done, the fire is suddenly extinguished, and the Anchovies alarmed, in seeking to escape are taken in the net. They are preserved with salt after removing the head and the intestines.

A very curious family, named

The **Anglers** (*Lophius*), is represented in our seas by a large and voracious species, bearing several homely appellations, such as the *Wide gab*, *Sea devil*, and more commonly the *Frog-fish* or *Fishing Frog*. In these fishes, the pectoral and ventral fins are

shaped like hands, and project so far from the surface of the body as to be capable of being bent

FIG. 269.—MARBLED ANGLER.

forward and used as feet, as represented in the accompanying figure (Fig. 269).

The **Common Angler** (*Lophius piscatorius*) (Fig. 268) is a large fish, sometimes attaining five feet in length. The head, as will be

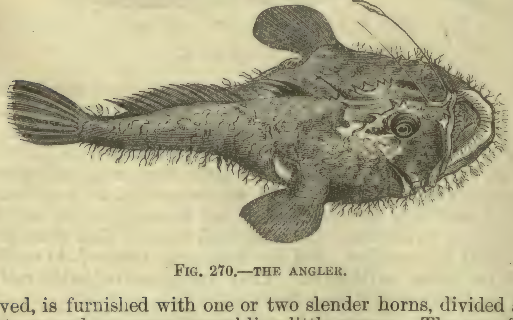

FIG. 270.—THE ANGLER.

observed, is furnished with one or two slender horns, divided at the tip into several processes resembling little worms. The use of these organs is very remarkable. The fish is not one gifted with swift motion, and therefore cannot take its prey by pursuit; instead of this it usually conceals itself in the mud at the bottom, or perhaps among the stalks of floating weeds, while it agitates its curious fleshy baits. Their resemblance to worms and their motion attract other fishes, which, coming within reach, are seized by the capacious mouth of the concealed frog-fish and swallowed at a gulp.

Order of Sub-brachial Soft-finned Fishes.

Malacopterygii Sub-brachiati.*

This Order is distinguished by the situation of the ventral fins, which are placed beneath the pectorals.

It contains four families, namely, the **Gadoids** (*Cod-fishes*), **Pleuronectes** (*Flat-fishes*), the **Discoboli** (*Lump-suckers*), and the **Echeneides** or **Remoræ.**

The **Gadoids** have the ventral fins sharpened to a point and attached beneath the throat: they are covered with soft small scales: most of them live in cold or temperate seas; and they afford mankind an abundance of good and wholesome food. To this family belong the Cod, the Haddock, the Whiting,

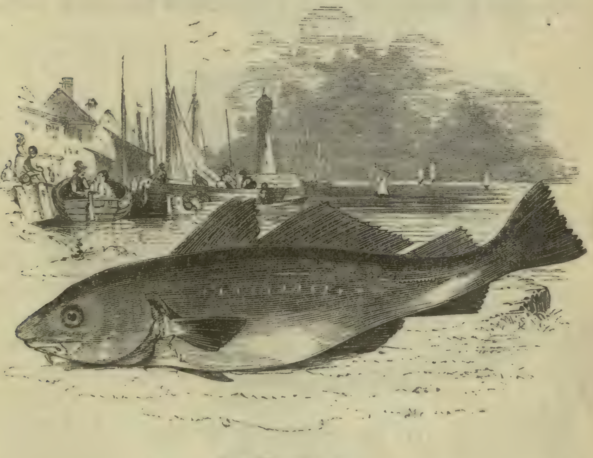

Fig. 271.—the cod.

the Coal-fish, the Pollack, the Hake, the Ling, and other species which, although little known with us, are valuable in other countries for their flesh, forming an important article of diet, both in the fresh state and when salted and dried. Many of the members

* Sub, *beneath ;* brachium, *the arm.*

of this family are remarkable for the number of their fins: thus it will be seen on referring to our engraving (Fig. 271), that the Cod has no fewer than ten, three dorsals, two pectorals, two ventrals, two anals, and the caudal. In some species, however, the dorsals are united into a single lengthened fin, as also are the anals. Most of them have short fleshy beards or tentacles depending from the lower jaw. The fishery for Cod is the most valuable in the world—the pursuit, the curing, and the transport affording employment to thousands of hardy industrious people, and whole fleets of ships. The value of the fish taken by British subjects, on the coast of Newfoundland alone, is not less than 500,000*l.* annually. They are caught with a hook and line.

The **Pleuronectidæ*** or **Flat-fishes**, have the body compressed laterally, and very much elevated verti-

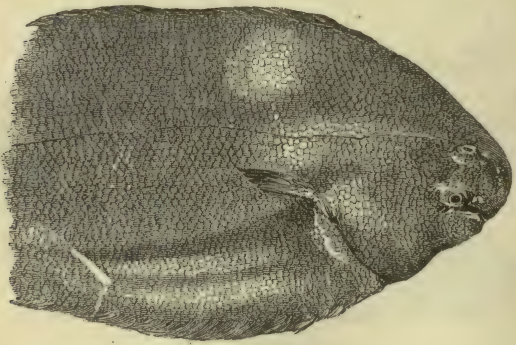

FIG. 272.—UPPER SIDE OF THE SOLE.

cally; but what especially distinguishes them is a want of symmetry in the construction of the head, a character which is not observed in any other vertebrate animal. Both eyes are placed on the side that is uppermost, which is deeply coloured, while

* πλευρόν, pleuron, *the side*; νήκτης, nektes, *a swimmer*, so called from their swimming on one side.

the other side is white. The two corners of the mouth are unequal, and it is rare to find both pectoral fins exactly alike; the dorsal fin extends along the whole back, the anal fin occupies the lower part

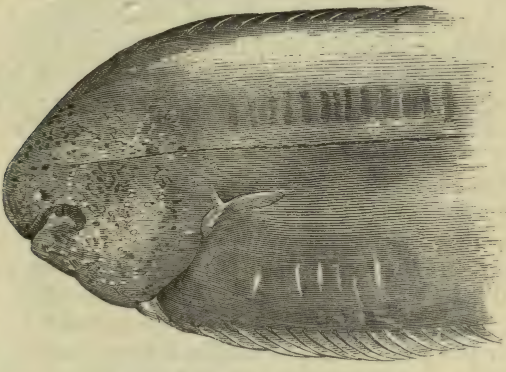

FIG. 273.—UNDER SIDE OF THE SOLE.

of the body, and the ventrals seem to be continuations of it in front, as they are almost united one to another. The principal genera of this family are the noble Turbot and Brill (*Rhombus*). The valuable Sole (*Solea*), the gigantic Holibut (*Hippoglossus*), the Plaice, the Flounder, and the various species of Dabs and Flukes (*Platessa*), all of which, in a greater or less degree, are in estimation as human food. Their form is very deep, but at the same time very thin, and they are not constituted to swim as other fishes do, with their back uppermost, but lying on one side. They reside wholly upon the bottom, shuffling along by waving their flattened bodies, fringed with the dorsal and anal fins; and as they are somewhat sluggish in their movements they need concealment from their enemies. This is afforded to them by the side which is uppermost being of a dusky brown hue, undistinguishable from the mud on which they rest; and so conscious are they where their safety lies, that when

alarmed, they do not seek to escape by flight, but sink down close to the bottom and lie perfectly motionless. In the structure of the head, again, there is a peculiar and very remarkable provision for the wants of the creature. If the eyes were placed as in all other animals, one on each side of the head, it is plain that the Flat-fishes, habitually grovelling in the manner described, would be deprived of the sight of one eye, which being always buried in the mud would be quite useless. To meet this difficulty the skeleton is distorted, taking near the head a sudden twist to one side; and thus the two eyes are placed on the side which is kept uppermost, where both are available. The side furnished with eyes and provided with dark colour varies in the different genera; in the Plaice, Flounder, and Sole, it is the right side; in the Turbot and Brill it is the left; while of the Holibut genus, some have the right and some the left side uppermost. Individuals are frequently found in which the usual order is reversed, and occasionally both sides are coloured; but these are casual exceptions. The value of these fishes may be estimated from the fact that London pays to the Dutch 80,000*l.* every year for Turbot alone.

The **Cyclopteri** * form a small group of sub-brachian fishes, distinguished by having their ventral fins united so as to form a broad disk, as in

The **Lump-sucker** (*Cyclopterus lumpus*). In this remarkable creature the pectorals and ventrals form but a single adhesive disk. The skin is without scales, but covered with a thick slime, and studded with hard tubercles arranged in regular lines. Its whole form is deep, thick, and short, and the first dorsal is enclosed in a thick tuberculated skin. This strange-looking fish is often taken upon our coasts. Notwithstanding its odd and uncouth form, it is beautifully and brilliantly coloured. The back and sides are tinted with deep blue, azure and purple, while the under surface and fins are of a rich orange. It is sometimes more than a foot and a half in length, and almost of the same depth. Slow of motion, and incapable of defence, it adheres to foreign objects by means of its disk so firmly that Pennant lifted a tub containing several gallons of

* κύκλος, cyclos, *a circle*; πτερόν, pteron, *a fin*.

water by seizing a Lump-sucker which had attached itself to the bottom.

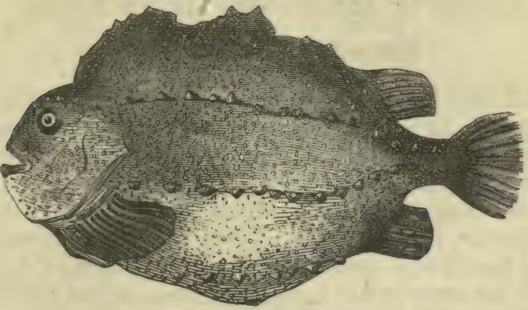

FIG. 274.—LUMP-SUCKER.

The **Sucking-fishes** (*Echeneis*)* are remarkable for the possession of a flattened disk that covers the back of their head, composed of a great number of moveable transverse cartilaginous plates, by the assistance of which the animal can attach itself to rocks, to vessels, or to other fishes, particularly to the shark. A species which lives in the Mediterranean and the Atlantic has been long celebrated under the name of

The **Remora,**† or **Sucking-fish** (*Echeneis Remora*), and its history is loaded with fable. It was pretended that this fish lived by a species of suction exerted by means of the disk above mentioned; and

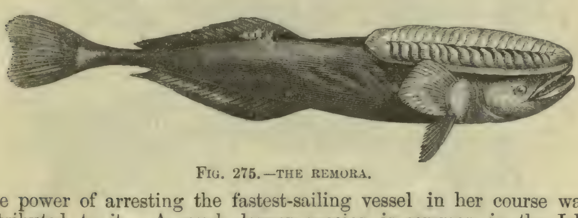

FIG. 275.—THE REMORA.

the power of arresting the fastest-sailing vessel in her course was attributed to it. A much larger species is common in the Isle of France; and it is said that on the coast of Caffraria it is employed in fishing, being sent off in pursuit of fishes and Turtles, and drawn in by a line attached to the tail as soon as it has fixed itself to its prey.

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* ἔχω, echo, *to hold;* ναῦς, naus, *a ship*, because they were thought to be able to arrest the course of ships at sea.

† Remora, *a hindrance*, so called because they were said to detain ships.

Order of Apodal Soft-finned Fishes.

Malacopterygii Apoda.*

All the fishes belonging to this Order have an elongated form, a thick, soft, and but slightly scaly skin: their chief characteristic, however, is their want of ventral fins. They form a single family,

The **Anguilliformes,**† which includes the *Eels, Gymnotus,* &c. All these fishes have the operculum very small, and opening far back by a hole or sort of tube, an arrangement enabling them to live for some time out of the water.

The **Eels** (*Anguilla*) are characterized by having the openings of the gills placed beneath the pectoral fins. They are too well known to require minute description. Eels are very voracious, and extremely

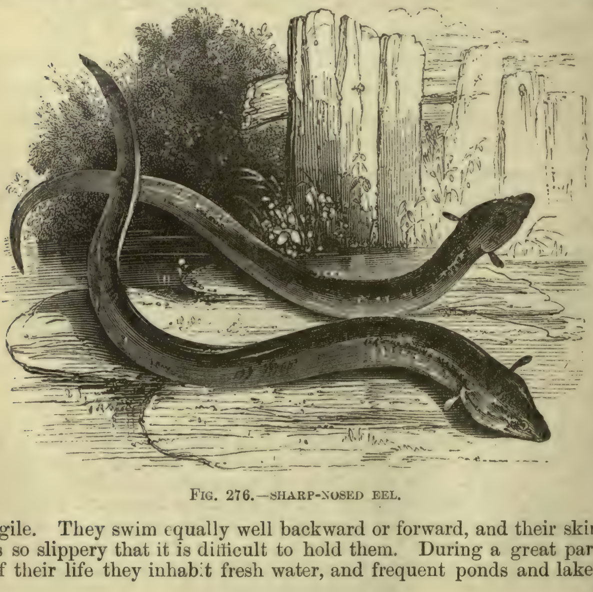

Fig. 276.—Sharp-nosed Eel.

agile. They swim equally well backward or forward, and their skin is so slippery that it is difficult to hold them. During a great part of their life they inhabit fresh water, and frequent ponds and lakes

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* α, a, *without*; ποῦς, ποδός, pous, podos, *feet.*

† Eel-shaped.

as well as rivers. By day they almost always keep buried in the mud, or lie concealed in holes that they excavate near the shore. These holes are sometimes very extensive, and lodge a great number of eels; but in general their diameter is small, and they open externally at both ends, thus enabling the animal to escape more easily when threatened with danger. When the season is very warm, and the stagnant waters of the pool begin to putrify, the eels leave the bottom and conceal themselves in the herbage of the shore, or even cross the land in search of a more favourable locality; they can, in fact, crawl on the ground like serpents, and remain a considerable time out of the water without perishing. Ordinarily they make these singular journeys during the night. When the ponds dry up they bury themselves in the sand and remain there till the water returns. The length of time they can remain in such a situation without perishing is surprising. In early life, eels inhabit the sea, and in the spring the young eels ascend rivers to dwell in fresh water, which, when full grown, they abandon to deposit their eggs in the sea.

The *Conger Eels* differ very little from common eels, except that they are of larger size, and always live in the sea or salt water.

FIG. 277.—CONGER EEL.

The **Murænæ** (*Muræna*) are entirely destitute of pectoral fins, and their branchiæ open on each side by a small hole. The most celebrated species is *Muræna helena*, which attains nearly three feet in length, and is marbled with brown and yellow. It is widely

FIG. 278.—MURÆNÆ.

spread through the Mediterranean, and was very highly esteemed by the ancients. The Romans reared them in great numbers in their magnificent fish-ponds, decorated them with jewels, and taught them

to come at the sound of their masters' voice. Ilirrias was the first to consecrate fish-ponds exclusively to Murænæ, and he caused six thousand of these fishes to be served up at an entertainment given to Cæsar when he was made Dictator.

The **Gymnoti*** have the gill-openings in front of the pectoral fins, and partially closed by a membrane. One of them,

The **Gymnotus Electricus**, or *Electric Eel*, is celebrated on account of the violent electric shocks it has the power of communicating at will.

The electric apparatus extends all along the back and tail, and consists of four longitudinal series of cells filled by a gelatinous matter, and supplied with very large nerves. These formidable fishes are so common in South America, that the roads are sometimes rendered impassable owing to the number of them infesting the streams that have to be crossed. As water is a conductor of electricity, a person may be struck at some distance, and small fishes are killed even at a distance of fifteen feet.

Order of Tuft-gilled Fishes.

Lophobranchi.†

Distinguished by the branchiæ which, instead of being pectinate (that is, having the form of the teeth of a comb), as is ordinarily the case, are divided into small round tufts, arranged in pairs along the branchial arches. These curious gills are enclosed under a large operculum, attached on all sides by a membrane, and having only a small hole for the escape of water. The Lophobranchiate fishes are also to be recognized by the mail-like plates that cover the body, and render it angular in shape; they are of small size. To this Order belong

The **Sea-Horses** (*Hippocampus*)‡: their body is laterally compressed and more elevated than the tail. When dried after death, the head and trunk bear

* γυμνός, gymnos, *naked;* νῶτος, notos, *the back.*

† λόφος, lophos, *a tuft;* βράγχια, branchia, *gills*—having tufted gills.

‡ ἵππος, hippos, *a horse;* κάμπη, campe, *a bending.*

some resemblance to those of a horse in miniature, which has obtained for this little fish the name of *Sea-horse*.

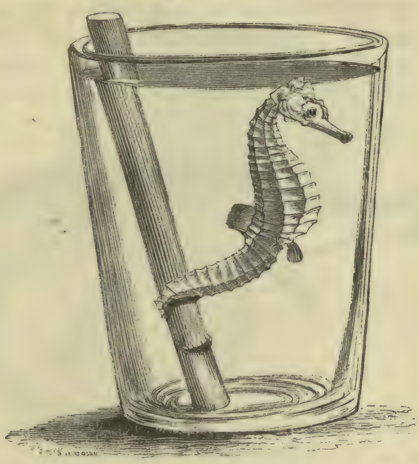

FIG. 279.—SEA-HORSE.

ORDER OF FISHES WITH CONJOINED JAWS.

PLECTOGNATHI.*

The chief distinctive character of these fishes is, that the maxillary is solidly fixed to the intermaxillary bone, and the whole united to the cranium, so as to be immoveable. Moreover, their opercula are concealed beneath a thick skin, which leaves externally only a small branchial slit. They have no true ventral fins.

In the family of **Gymnodonts** † there are apparently no teeth, but the jaws are furnished with a species

* πλεκτός, plectos, *twisted, conjoined;* γνάθος, gnathos, *the jaw.*
† γυμνός, gymnos, *naked;* ὀδούς, ὀδόντος, odous, odontos, *a tooth.*

of beak, internally divided into plates which form a grinding surface. To this family belong

The **Globe Fishes** (*Diodon*),* so called because their jaws being undivided have each but a single tooth-like piece, and the **Tetradons**,† in which both jaws are divided in the middle, so as to present the appearance of four teeth, two above and two below.

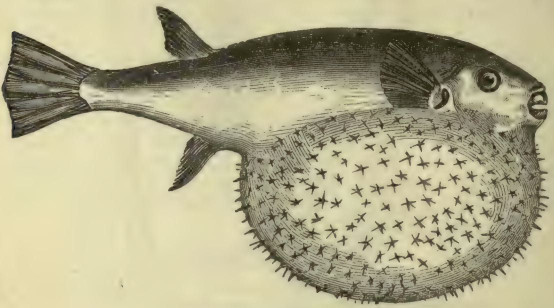

FIG. 280.—GLOBE-FISH.

These two genera of fishes have the faculty of swelling themselves up like a balloon by swallowing air; this peculiarity has obtained for them the common names of Swell-fish, Porcupine-fish, Balloon-fish, &c., and furnishes them with a means of defence, for when the skin is distended, the spines with which it is armed become everywhere erect, and project from the whole surface of the body; when thus swollen, they turn over, the belly coming uppermost, and thus they float on the surface of the sea. They are found in tropical climates.

The **Sun Fishes** (*Orthagoriscus*,‡ *Mola* §), sometimes also called *Moon-fishes*, resemble the Diodon in the arrangement of their jaws, but the body is compressed and of a strange shape; it has no spines, nor is it susceptible of inflation, and their tail is so short and so high vertically, that they look like fishes with the hinder part cut off. One species, which sometimes attains more than four feet in length, weighing about three hundred pounds, is occasionally taken off our own coasts.

* δίs, dis, *double*; ὀδόυς, ὀδόντος, odous, odontos, *a tooth*.
† τετρα, tetra, *four*; ὀδόυς, ὀδόντος, odous, odontos, *a tooth*.
‡ ὀρθαγορίσκος, orthagoriscos, *a sucking-pig*.
§ Mola, *a mill-stone*.

FIG. 281.—SUN-FISH.

The **File Fishes** (*Sclerodermes*)* are easily distinguished by their conical or pyramidal snout, prolonged from the eyes, and terminated by a small mouth

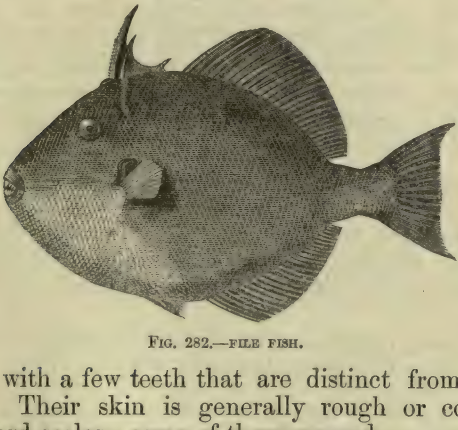

FIG. 282.—FILE FISH.

armed with a few teeth that are distinct from each other. Their skin is generally rough or covered with hard scales; some of them, named

Balistes, have a compressed body covered by a scaly

* σκληρός, skleros, *hard;* δέρμα, derma, *skin.*

or granular skin (not bony); they have eight teeth, generally trenchant, arranged in a single row in each jaw, and two dorsal fins. They are found in great numbers in the Torrid zone. Others, called

Trunk Fishes (*Ostracion*),* have, instead of scales, an inflexible coat of mail made up of bony plates, which covers the head and body, so that they can only move their tails, their fins, and their mouth, all of which protrude through apertures in their remarkable armour. Each jaw is armed with ten or twelve conical teeth. They are common on the coast of America.

Division of Cartilaginous Fishes.

Chondropterygii.†

The **Chondropterygii** differ from all the fishes we have as yet spoken of in the following particulars. Their skeleton is cartilaginous, and always more simple in its conformation than that of osseous fishes. The skull is composed of a single piece, but shaped in other respects very much like that of an ordinary fish. The maxillary and intermaxillary bones do not exist, or are found only in a rudimentary state, concealed beneath the skin. The lower jaw is constituted of one piece on each side, and the opercular apparatus is in general entirely wanting.

Sometimes the gills are free on their external edge, as in the osseous fishes; sometimes, on the contrary, they are attached by both edges, and from this circumstance the Chondropterygii are divided into two groups.

1. Those with free branchiæ (Sturgeons).
2. Those with fixed branchiæ (Sharks, Rays, &c.).

The **Sturgeons** (*Acipenser*) have the general form of osseous fishes; their body is more or less covered with plates of bone

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* ὄστρακον, ostracon, *a shell.*

† χόνδρος, chondros, *cartilage;* πτερύγιον, pterygion, *a fin.*

imbedded in the skin in longitudinal rows. Their mouth is adapted for suction, and unprovided with teeth. These fishes are generally large, and endowed with considerable muscular strength. They easily stem the most rapid current, and can strike violent blows with their tail; but their habits are ordinarily peaceful, and they are

FIG. 283.—THE STURGEON (*Acipenser Sturio*).

formidable only to small unarmed prey. They feed on herrings, mackerel, and sometimes salmon, and also root in the mud for worms and mollusks. In the spring they ascend certain rivers from the sea, often in numerous shoals, to deposit their eggs. Their fecundity is very great. We are assured that 1,500,000 eggs have been found in a single female that weighed 270 lbs., and in another weighing 2,800 lbs., the spawn alone weighed 800 lbs.

The young ones seek the sea very early and remain there till full grown. The flesh is wholesome; and from their eggs a kind of food is prepared, much esteemed in the north of Europe, called *Caviar*. It is chiefly from the swimming bladder of these fishes that isinglass is manufactured.

The *Polyodon*, or *Spatularia*, a fish allied to the Sturgeon, is found in the Mississippi; it is remarkable for an enormous prolongation of the muzzle, to which its wide borders give the figure of a leaf. The mouth is well cleft, and furnished with several small teeth.

The **Chimæras** form a connecting link between the preceding and the Sharks.

FIG. 284.—NORTHERN CHIMÆRA.

CARTILAGINOUS FISHES WITH FIXED BRANCHIÆ.

CHONDROPTERYGII BRANCHIIS FIXIS.

In this division of cartilaginous fishes the gills, instead of being free on their external edge and suspended in a common cavity, from which the water escapes by a single opening, are adherent to the skin, so that for the escape of the water that passes over them there are as many openings as there are intervals between the branchiæ. In other respects these fishes differ very much from each other. They are divided into two orders, distinguished by the structure of their jaws, viz.,

The **Plagiostomes*** and the **Cyclostomes.†**

ORDER OF PLAGIOSTOMES.

This Order comprises the Sharks and the Rays, or Skates. They have both pectoral and ventral fins, five branchial openings on each side of the neck, or on its inferior face, and the jaws are armed with teeth. They lay eggs covered with a hard horny shell (Fig. 286).

The **Sharks** (*Squalidæ*) are recognisable by their

* πλάγιος, plagios, *oblique ;* στόμα, stoma, *the mouth ;*—having their mouths placed transversely.

† κύκλος, cyclos, *a circle ;* στόμα, stoma, *the mouth ;*—having circular mouths.

general form, which differs but little from that of ordinary fishes. Their skin is covered with a mul-

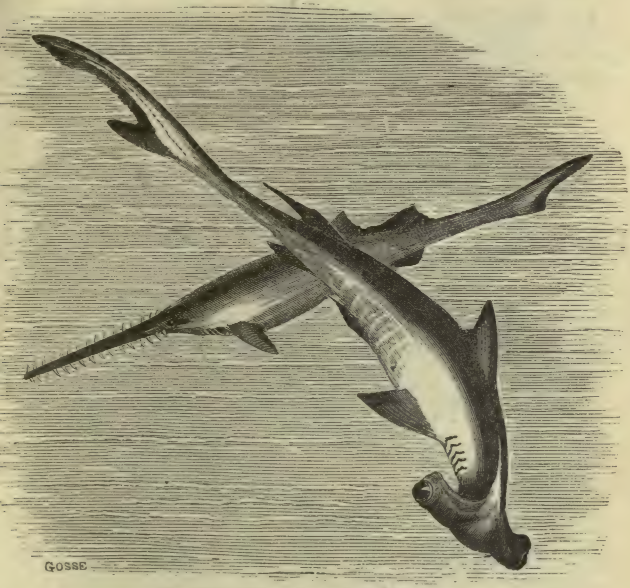

FIG. 285.—HAMMER-SHARK AND SAW-FISH.

titude of small spines of stony hardness, and becomes very rough on drying, so as to form a sort of file (shagreen), much employed in the arts for polishing

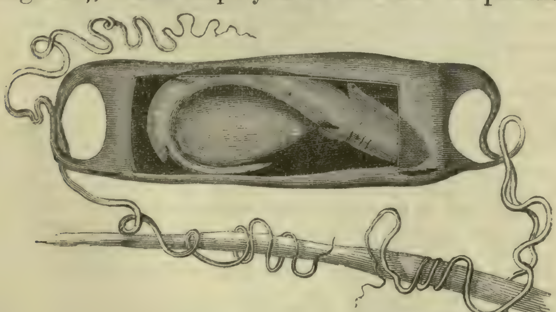

FIG. 286.—SHARK'S EGG.

hard bodies, such as ivory. Among these tyrants of the deep we may select for special notice

The **White Shark** (*Squalus Carcharias*), which attains twenty-five or thirty feet in length, and is celebrated for its ferocity. Its vast mouth is furnished with triangular moveable teeth, the number of which increases with age. In the young there is but a single row,

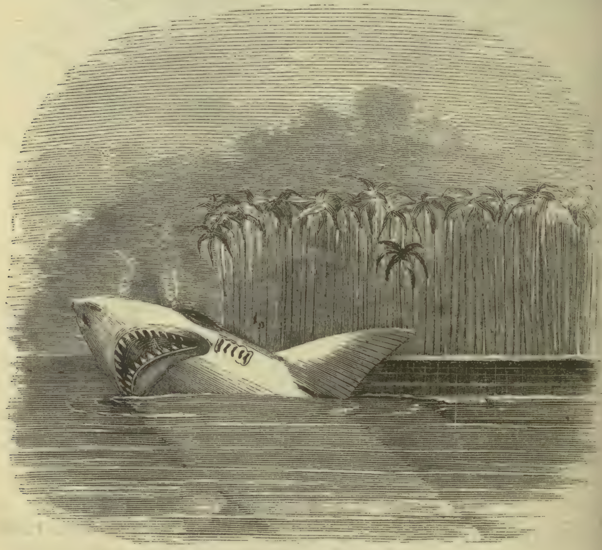

FIG. 287.—WHITE SHARK.

in the adult six. The strength of this fish is very great, and its motions rapid; its voracity knows no bounds; hence it is amongst the most dangerous of animals. Men frequently become its victims, and as many as eight or ten tunnies have been found at once in its stomach. Seals, tunnies, and cod-fish are the ordinary food of sharks, but they attack dead bodies, and even devour each other.

The shark, indeed, is omnivorous; he will swallow anything, from tin-pots and canvas to fat pork and anchovies. In the stomach of one taken in the harbour at Sydney were found half a ham, several legs of mutton, the hind quarter of a pig, the head and fore-legs of a bull-dog, with a rope round its neck, a quantity of horseflesh, a piece of sacking, and a ship's scraper. This catalogue would form an interesting fact for a work on 'Digestion and its Derangements.' From the liver of this fish twelve gallons of oil were obtained.—DR. BENNETT.

The **Greenland Shark** (*Læmargus borealis*) is a large animal, twelve or fourteen feet in length or more, and six or eight in circum-

ference. It is harmless to man, but an enemy to whales, biting and tearing these superior monsters when alive, and eating them up

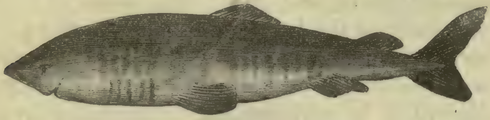

FIG. 288.—GREENLAND SHARK.

when they die, gorging itself with blubber, like an Esquimaux, scooping hemispherical pieces, each as large as a man's head, out of the whale's body, and swallowing as much as ever it can, until it has so filled itself, that it has no place wherein to stow away any more; heeding no annoyance, not even the stab of a knife at dinner-time, and contenting itself with a fasting diet of small fishes and crabs on those days when whale-beef is not to be procured.—Mr. AUSTEN.

The **Saw-fishes** (*Pristis*) (Fig. 285) are especially distinguished by their very long snout, in the form of a sword-blade, armed on each edge with strong bony spines, which are pointed and cutting; this terrible weapon enables its possessor fearlessly to attack the largest whales. The teeth covering the jaws resemble a pavement of small pebbles. The common Saw-fish attains a length of twelve or fifteen feet.

The **Skates** (*Raia*) form a large tribe, of which the common Thornback is a familiar example.

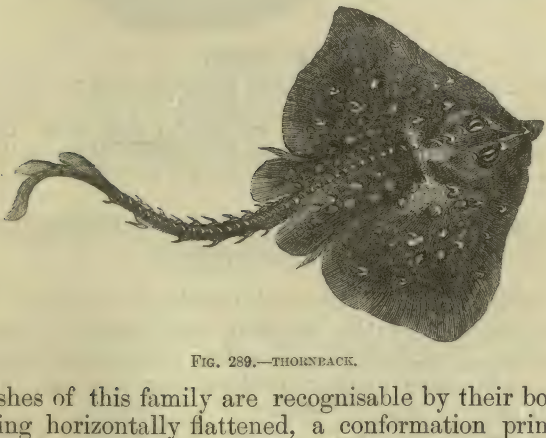

FIG. 289.—THORNBACK.

Fishes of this family are recognisable by their body being horizontally flattened, a conformation principally due to the disposition of their pectoral fins; these are extremely broad and fleshy, and joined

to each other, or to the muzzle in front, and extend backwards on both sides of the abdomen, nearly to the base of the ventral fins. The eyes are placed upon the back of the head. The mouth, the nostrils, and the openings of the branchiæ are on the ventral surface of the body; the dorsal fins are situated upon the tail, which is very slender. Our coast furnishes many species.

To this family belong

The **Torpedos**, or **Electric Rays**, celebrated for their power of giving electric shocks. Their electric apparatus consists of a multitude of vertical membranous tubes placed close together like the cells of a honeycomb: these cells are filled with mucus and largely

FIG. 29).—TORPEDO.

supplied with nerves. The Torpedos are less powerfully electrical than the Gymnoti, but can nevertheless benumb the arm of a person touching them, hence they are called Cramp-fishes. They probably use their electrical batteries as a means of obtaining their prey. They are frequently met with upon our southern coasts.

ORDER OF CYCLOSTOMES, OR CIRCULAR-MOUTHED CHONDROPTERYGIANS.

This, the last order of cartilaginous fishes, is characterized by the singular conformation of the mouth. Their body is elongated, naked, and slimy, and they have neither pectoral nor ventral fins; such are

The **Lampreys** (*Petromyzon*),* recognisable by seven

* πέτρος, petros, *a stone*; μύζω, myzo, *to suck*.

branchial openings placed on each side of the neck, and by their circular mouth, armed with several ranges of strong teeth; the tongue is also furnished with teeth, and is carried forward and backward like a piston, thus enabling the animal to use its mouth, not only to suck in the materials upon which it feeds, but to attach itself to solid bodies. The skin of these fishes above and below the tail is raised into a vertical crest, which takes the place of fins.

The **Sea Lamprey** (*Petromyzon-marinus*) is two or three feet long, and marbled with brown on a yellowish ground, it inhabits the coasts both of Europe and America, and in the spring ascends rivers

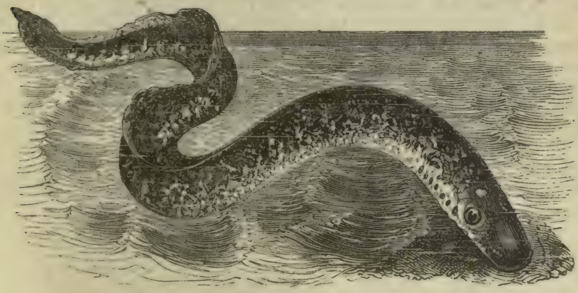

FIG. 291.—LAMPREY.

to deposit its eggs. It ordinarily preys upon marine mollusca, or fragments of dead animals; but it also attaches itself to large fishes, and succeeds in piercing their skin and destroying them. Its flesh is much esteemed.

The **Fresh-water** or **River Lamprey** (*Petromyzon fluviatilis*) is a smaller species, seldom exceeding eighteen inches in length; it

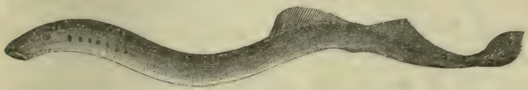

FIG. 292.—RIVER LAMPREY.

passes the greater part of the year in fresh-water lakes, which it abandons in the spring to enter rivers. Its colour is dark olive, yellowish, and silvery beneath.

A third species is.

The **Lampern**, or Small River Lamprey, about eight or ten inches in length; it also inhabits fresh waters, and is distinguished from the

former by its dorsal crests, which are continuous or united instead of being distinct.

The **Hag-fishes** (*Myxine*)* have the mouth armed above by a single fang-like tooth, while the tongue is furnished on each side with two horny plates deeply serrated, so that at first sight they might be supposed to be lateral jaws, like those of articulated

FIG. 293.—MYXINE.

animals. In other respects, the organization of the Hag-fish resembles that of Lampreys. Their body is cylindrical, and furnished posteriorly with a crest that surrounds the tail; their mouth is circular, surrounded by eight cirri, and its upper margin is pierced by a spiracle. They have no vestiges of eyes, and their body is lubricated with a great quantity of mucus. Thus provided, the Myxine, when it attacks its prey, uses its mouth like a cupping-glass—plunging its fang into the flesh of its victim, and thus securing a firm hold, the lingual saws tear their way into its very vitals.

The **Ammocætes,**† the lowest of the Myxines, have a completely soft and membranous skeleton. They keep in the mud of small streams, and exhibit many of the habits of worms, which they also resemble in their shape.

CHAPTER XXIII.

REPTILES.‡

THE word Reptile simply means that the animals so designated creep or crawl upon the ground; and, in a general sense, is sufficiently applicable to the class that next offers itself to our contemplation. In some, their unwieldy body, scarcely supported by their short and stunted limbs, presents an uncouth and hideous appearance; whilst others, furnished with no limbs at all, progress with serpentine movement along the surface of the ground. These animals have ever been looked upon by mankind with involuntary ab-

* μυξῖνος, myxinos, *slime-fish.*

† ἄμμος, ammos, *sand;* χαίτη, chaite, *horse-hair.*

‡ Repto, *to creep or crawl.*

horrence, and, by all nations, either despised for their stupidity or dreaded for their malignity.

The naturalist, however, finds that the power of the Almighty is manifested with as much glory in these vile objects of universal detestation, as in the more favoured races of Creation. He sees nothing in the class of Reptiles but animals singular in their forms, curious in their structure, marvellous in their metamorphoses, and admirably adapted, by their habits, to the duties imposed upon their different races. Few beings, indeed, are more worthy of the attention of the thinking observer, than these proscribed and persecuted creatures; and, as the reader need not fear to accompany us into their gloomy haunts, we may at least peep behind the broken masses of rock where they hide, display them coiled up beneath the rotting vegetation of the forest, see them swimming in the streams or wallowing in the marshes, and observe the mechanism by which they have been enabled to creep, or climb, or walk, or run, or leap, or even fly. Neither are they ill adapted for their appointed localities, or inharmonious with the scene around them. It is in the dismal swamps of tropical regions that we must see the Reptile races in their full luxuriance—where the rivers slowly roll along their sluggish waves, or spread out in broad swamps, which, far and wide, cover the alluvial slime they have deposited. These vast morasses, steaming with fetid fogs and pestiferous exhalations, alternately inundated and left dry, where earth and water appear to contend for undefined possessions, are peopled only by the Reptile forms indigenous to such localities. Enormous serpents, trailing their length along, impress the miry soil with tortuous tracks. Crocodiles and Toads knead with their sprawling feet the yielding clay; huge Alligators lurk in ambush, and a thousand hideous things withdraw themselves from observation. The Reptile occupying this intermediate domain, between the waters and the land, is neither a perfect quadruped

nor a true fish, but a sort of ambiguous production sharing the attributes of both. Let us, however, examine their structure a little more closely.

In Reptiles the circulation is arranged in such a manner, that the heart, at each contraction, sends into the lungs only a small portion of the blood received from the various parts of the body; so that the bulk of the circulating fluid returns to the system without having passed through the lungs, and undergone the process of respiration.

It is respiration that communicates to the blood its heat, and to the muscles their irritability. We find, therefore, that Reptiles have cold blood, and that their muscular power is, upon the whole, less than that of the quadrupeds and birds. Accordingly, their movements are generally confined to those of creeping and swimming; and although many of them can leap and run quickly upon some occasions, their general habits are lazy, their digestion excessively slow, their sensations obtuse, and in cold and temperate climates they pass almost the entire winter in a state of lethargy. Not possessing warm blood, they have no occasion for clothing capable of retaining heat, and they are consequently covered with scales, or simply with a naked skin. As another consequence of their want of vital warmth, no Reptile sits upon its eggs, which frequently have only a membranous envelope, and are left to be hatched entirely by the heat of the sun, or of the soil in which they are deposited.

The class of Reptiles is of great extent, and embraces many forms of animals that differ widely from each other, both in their structure and habits; they may, however, be grouped under four principal sections, characterized as in the following Table:—

CLASS OF REPTILES.	Undergoing no metamorphosis. Respiration always aërial. No branchiæ at any time. Body covered with scales, rings, or a carapax	Having limbs furnished with moveable eyelids.	Covered by a carapax. Jaws without teeth and covered with a horny beak . .	**CHELONIA.**
			Without a carapax. Jaws armed with teeth and without a horny envelope . .	**SAURIA.**
		Destitute of limbs, generally without moveable eyelids—provided with teeth		**OPHIDIA.**
	Undergo a transformation in early life—respiration at first aquatic, and effected by the aid of gills—then aërial and pulmonary. Skin naked, without carapax or scales: no nails—almost always provided with limbs			**AMPHIBIA.**

CHAPTER XXIV.

AMPHIBIA.*

THE globe that we inhabit is usually said to be made up of land and water, and, perhaps, for the purposes of the geographer, such a division is all that is requisite. A little reflection, however, will convince the naturalist that a very considerable portion of the world around us can scarcely be referred to either of these geographical sections. That there are extensive marshes, for example, equally unfit to be the habitation of aquatic animals, as of creatures adapted to a purely terrestrial existence; that some localities may be alternately deluged with water and parched with drought, thus the margins of our lakes, the banks of our rivers, and the shallow pools and streamlets of warm climates can only be adequately populated by beings of an amphibious character, alike capable of living in an aquatic or in an aëriform medium, and combining in their structure the conditions necessary for enabling them to reside in either element.

Aquatic animals, strictly so called, breathe by means of gills; to adapt a vertebrate animal to respire air, it must be provided with lungs, consisting of membranous bags more or less divided internally into numerous cells, over which the blood-vessels spread like an admirable net-work, fitted for appropriating oxygen from the air of the atmosphere instead of from water. But if a creature is destined to live both in air and in water, it must obviously be provided with both gills and lungs coexistent, either of which may be employed in conformity with the necessities of the moment. We cannot, therefore, be surprised that, in the lowest Reptiles, this is literally the arrangement adopted; that they respire,

* *αμφίs*, amphis *both;* *βιόω*, bioo, *to live*—living in two elements.

like fishes, by means of branchiæ or gills while in the water, whereas on emerging into the air they have lungs at their disposal. Such, for example, is the case with

The **Mud Fish** (*Lepidosiren * Protopterus*†). These animals are met with both in Africa and America; they are only found in the ditches of the rice-fields, which are for more than half the year under water, while during the other half they are dry. While the

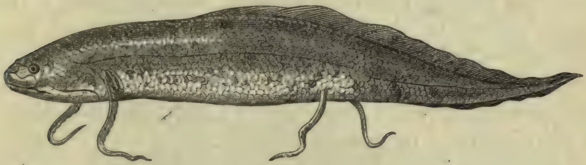

FIG. 294.—MUD-FISH.

tropical rains continue, or as long as the waters prevail, the creature breathes by gills, and lives the life of a fish, which, in outward form, it much resembles; but when the water begins to dry up, it burrows into the mud that a vertical sun speedily bakes into a hard crust. An aperture, however, is left in this clayey cell, by which air is admitted, and therein the mud-fish, enveloped in a thick coat of slime, passes the dry season rolled up and in a torpid condition. In this state they are dug out of the ground like potatoes and fried like Eels.

The Lepidosiren above described, from its scaly covering, seems properly to belong to the Class of Fishes, notwithstanding its amphibious capabilities; but there are numerous creatures, decidedly reptilian, equally provided with both kinds of respiratory apparatus.

The number of animals that in their adult state are so furnished is very small; but there are many

* *λεπίς—ιδος*, lepis—lepidos, *a scale;* siren, an annual noticed further on—Scaly Siren.

† *πρῶτος*, protos, *first; πτερόν*, pteron, *a wing or fin—i.e.* with rudimentary fins.

which, at an early period of their existence, are thus organized, and at different periods of their lives possess both lungs and gills. Some of these, when very young, have gills only, and, like fishes, respire water; but as they advance in age, the gills become obliterated and lungs are developed.

Such are the Frogs, Toads, and Newts, called, from this circumstance, *Caducibranchiate* Amphibia*, or Amphibious animals with perishable gills. In another group, the gills are persistent through life, even after the lungs are completely formed, and, of course, animals so provided can live indifferently, either in the air or in water. These are called *Perennibranchiate† Amphibia*, or Amphibious animals with perennial or persistent gills.

Animals of this description present many characters in common: instead of being covered with scales, their skin is naked, smooth, and often moist. Their body is either depressed and squat as the Toad and Frog, elongated like the Salamanders or Newts, or worm-like as in the Cæcilias. The head is flattened and joined to the body, without the intervention of a neck. They have no ribs, and their toes are not furnished with claws or nails.

The Amphibia thus distinguished are classified as follows:—

FOOTLESS AMPHIBIA (*Apoda*).‡

The Amphibia, which, from their total want of limbs, have been termed *Apoda*, so much resemble snakes in their general form, and even in some particulars of their internal structure, that Cuvier arranged them with the serpents, and by the superficial observer, they might almost be mistaken for worms; such are

The **Blind Worms** (*Cæcilia*).§

* Caducus, *easily falling;* branchiæ, *gills.*
† Perennis, *perennial;* branchiæ, *gills.*
‡ *α*, a, *without;* *πους*, *ποδος*, pous, podos, *a foot—footless.*
§ Cæcus, *blind.*

The body of these creatures is very nearly cylindrical. Their skin is smooth, and transversely furrowed by annular wrinkles. At first sight it appears to be completely naked; but, on dissection, small and extremely thin scales are found. The eyes, which are very small, are concealed beneath the skin, and sometimes are entirely

FIG. 295.—TWO-LINED CÆCILIA.

wanting. These reptiles inhabit humid and shady places, make holes in the ground, and seem to feed on vegetable substances as well as on worms and small insects; they are found in South America and in the East Indies. Gills are said to have been discovered in a young specimen, but no trace of them is to be seen in the adult.

AMPHIBIA WITHOUT GILLS.

ABRANCHIA.*

A few creatures found in the Southern United States constitute this limited group. They are exceedingly like Eels; the body being greatly lengthened, smooth and flexible, and though they have

* α, a, *without;* βράγχια, branchia, *gills.*

four limbs, these are so minute, so rudimentary, and placed so far apart, as scarcely to affect this eel-like contour. The toes on their feet are scarcely more than little pimples.

These animals appear to form an exception to the universality of *metamorphosis* in the Class. They habitually reside in the water, but are exclusively air-breathers, no gills having been observed at any stage of their life, though there is an orifice on each side of the neck. The eyes are small, and the bones of the spine present, both in front and rear, that concavity which marks the *vertebræ* of Fishes. To this Order belong

The **Amphiumas**, called by the negroes, who erroneously regard them as being exceedingly venomous "*Congo Snakes.*" They live in

FIG. 296.—TWO-TOED AMPHIUMA.

muddy waters, or in mud, being sometimes found three feet deep in

mud of the consistence of mortar, into which they burrow like an earthworm. They inhabit the ditches of rice-fields, and feed on small fish and fresh-water mussels, beetles, and other insects. Sometimes they are found on dry land. They pass the winter season in the mud, collecting together at that time in great numbers, and remain in a state of torpidity till the spring.

The **Gigantic Salamander** (*Sieboldia maxima*) was discovered by

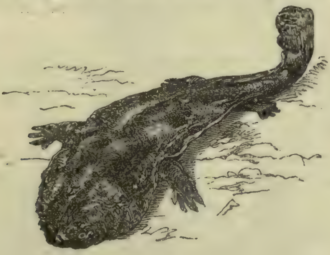

FIG. 297.—GIGANTIC SALAMANDER.

the celebrated naturalist Von Siebold, in Japan. It is a hideous-looking animal, with four toes on the front and five on the hind feet.

Another large species met with in the fresh waters of North America has received from our Anglo-American brethren the pretty names of

The "**Hell-bender,**" the "*Mud-devil,*" and many others equally expressive of esteem and regard.

AMPHIBIA WITH PERMANENT GILLS.

PERENNIBRANCHIATA.

This family is composed of animals that always preserve their branchiæ, and resemble in their structure the tadpoles of Newts. Indeed, they were at first regarded as being the young of some large species of Triton; but there is now no doubt of their being perfect animals, and what is very remarkable, possessing as they do, well-developed branchiæ, they have also lungs, and are consequently completely amphibious. Their body terminates in a long vertical tail; their limbs are but little developed, and the hinder pair is sometimes wanting. Four genera are known, namely,

the **Axolotus**, the **Menobranchus**, the **Proteus**, and the **Siren**.

The **Axolotle** (*Axolotus*) in every respect resembles the tadpoles of Salamanders that have acquired both their fore and hind legs. The gills project from orifices on each side of the neck, and take the form of branched tufts, as may be seen in the accompanying figure, representing the *Axolotus pisciformis*, an animal inhabiting the lakes

FIG. 298.—AXOLOTLE.

of Mexico. It is about ten inches in length. It is said to be commonly sold in the market of Mexico, and to be esteemed as a luxury by the inhabitants, dressed in the manner of stewed eels, and served up with rich sauce. Humboldt declares that he found it savoury and wholesome. Lake Champlain, in Canada, produces a species much resembling this, but three or four times as large.

The **Snake-like Proteus** (*Proteus anguinus*). The native place and abode of the Proteus is the water in some subterranean caverns in the limestone of the south of Europe, as, for example in that of Adelsburg in Carniola. This cavern was visited by the late Sir Humphry Davy, who has left us a very interesting account of it and its strange inhabitant. "At first view, you might suppose this animal to be a lizard, but it has the motions of a fish. Its head and the lower part of its body all bear a strong resemblance to an Eel; but it has no fins, and its curious branchial organs are not like the gills of fishes. They form a singular vascular structure almost like a crest round the throat, and they may be removed without causing the death of the animal, which has also lungs. With this double apparatus it can

live either in or out of the water. Its fore-feet resemble hands; but they have only three fingers, and are too feeble to be of any use in

FIG. 299.—PROTEUS.

supporting the weight of the animal, while the hinder feet have only two claws or toes."

The **Mud Eel** (*Siren lacertina*) almost exactly resembles an Eel

FIG. 300.—SKELETON OF SIREN.

in its general shape; but, instead of fins, has legs. These, however, are only two in number, representing the anterior pair; they are very short and feeble, and of little service in progression, either when in the water or on land; they are terminated by four toes. These animals, as the English name indicates, live chiefly in mud, and are abundant in the rice-fields of Carolina, where, when the ditches

are cleared, they are often thrown out in great numbers. Being regarded as venomous by the slaves, they are instantly killed, or dreadfully mangled. Sometimes they leave the soft mud, in which they usually burrow, and take to the water, where they swim with great quickness. They are occasionally taken by persons angling with a bait of Earthworms. Sometimes, like Eels, they leave the water and are found on dry land. A specimen, which was kept alive in the Zoological Gardens in the Regent's Park, devoured about a dozen and a half of Earthworms daily.

BATRACHIAN AMPHIBIA.

The name *Batrachian* (from the Greek *βατράχος*, *a frog*) is given to those Amphibians that resemble a frog in their structure and general habits. All the Batrachians, when young, undergo a series of transformations or metamorphoses, so that they enter life under an entirely different form from that which they afterwards assume. In their first condition they are usually designated *Tadpoles.*

When the young tadpole first leaves the egg it resembles a little fish, and can live only in water. Its head is very large, its belly protuberant, and its body quite destitute of

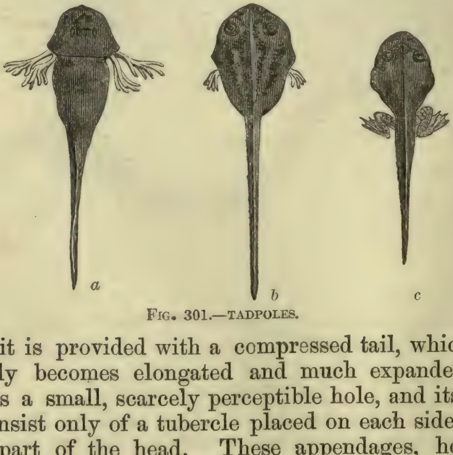

FIG. 301.—TADPOLES.

limbs; it is provided with a compressed tail, which subsequently becomes elongated and much expanded. Its mouth is a small, scarcely perceptible hole, and its branchiæ consist only of a tubercle placed on each side of the hinder part of the head. These appendages, however, very soon lengthen and become divided into shreds (Fig. 301*a*). The eyes grow perceptible through the skin, and a small transverse slit appears under the neck, form-

ing a sort of membranous operculum. A little later the branchiæ become ramified, and the lips are covered with a minute horny beak, by the aid of which the little animal fixes itself to vegetables that form its chief food; but this state does not last long. At the end of a few days the branchial fringes, appended to each side of the neck, begin to disappear (Fig. 301*b*), and respiration is carried on by means of small tufts of blood-vessels, placed along four cartilaginous arches, situated under the throat. A membranous tunic, covered by the skin, envelopes these internal branchiæ, to which the water arrives by the mouth, and, after having laved these organs, escapes through one or two external slits, the situation of which varies a little in different species. The respiratory apparatus, now, exactly resembles that of fishes. Some time afterwards the hinder legs of the tadpole show themselves, and are developed little by little (Fig. 301*c*). These attain considerable length before the front legs are perceived beneath the skin, which at a later period they penetrate. About the same time the horny beak falls off, leaving the jaws unencumbered. The tail begins to waste away; the lungs are developed, and, in proportion as these organs become more exclusively the seat of respiration, the branchiæ fade and disappear. Finally, in Frogs and Toads the tail is altogether lost, the animal assumes the form that it preserves through life, and completely changes its regimen. From being at first herbivorous, it gradually becomes exclusively carnivorous, and all its digestive apparatus is changed accordingly. The period of these changes varies from about four to eight weeks, according to the species; and it has been ascertained that different circumstances may considerably hasten or retard the completion of their metamorphosis. A deficiency of light and heat very much prolongs the duration of the tadpole state.

Having reached their perfect condition, the frogs cease to be aquatic animals; but most of them continue to live in the neighbourhood of water, and dive frequently into it.

The Batrachia are divisible into two sections, those that preserve their tail in their adult state (*Urodela*), and those that lose that member altogether (*Anoura*). Those that retain their tail walk badly: owing to the feebleness of their limbs they can only drag their

bodies along the ground, and usually live in the water—such are the *Newts.* Those, on the contrary, which lose their tail, as the Frogs, walk or even leap with facility.

TAILED BATRACHIANS (*Urodela*).*

In this division, which comprehends the Newts and the Salamanders, the tail, so characteristic of the tadpole condition, remains large, long, and well developed through life.

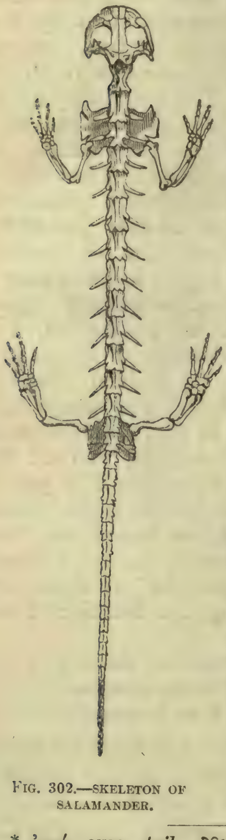

FIG. 302.—SKELETON OF SALAMANDER.

The accompanying figure of the skeleton of one of these animals will display its general form and structure; the body is slender, lengthened, and lizard-like; the limbs are four in number, and furnished with small, well-formed toes; the *vertebræ* are numerous and flexible, the ribs mere rudiments and very short.

The **Terrestrial Salamander** (*Salamandra*) is a harmless little reptile, "from six to eight inches long, thicker and fuller than a lizard, having a pale white belly, and one part of the skin exceeding black, the other yellow, both of them very splendent and glistening, with a black line going down the back, having upon it many little spots, like eggs." This "daughter of fire, with a body of ice," was formerly, and is still, in some parts believed to be able to brave the violence of fire, to pass through it unhurt, and even to extinguish it in its course, with how much truth we leave our readers to judge. The young of the Salamander are produced alive and fully formed; they only differ from the mother by the possession of gills. The Salamander inhabits Central Europe, and occurs in many parts of France.

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* οὐρά, oura, *tail;* δῆλος, delos, *manifest—i.e.,* having a conspicuous tail.

The **Great Warty Newt** (*Triton cristatus*) is one of the most common and the largest of the British species. It lives upon aquatic

FIG. 303.—SMOOTH NEWT.

insects, and other small animals, and also upon tadpoles; it is everywhere to be found in ponds and large ditches.

The **Smooth Newt** (*Lissotriton punctatus*) likewise abounds in our

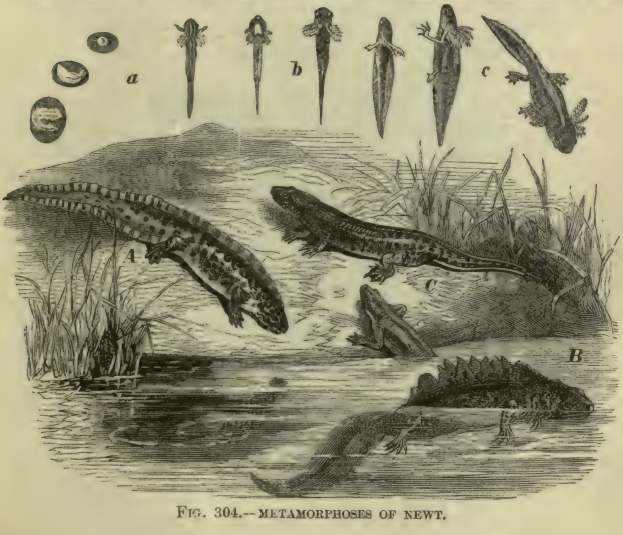

FIG. 304.—METAMORPHOSES OF NEWT.

ditches and ponds, in which it may be seen throughout the summer, crawling on the bottom, climbing the stems of plants, swimming with a wriggling motion through the water, or coming to the surface to breathe the air. The male frequently displays the under-surface of his body, which is of a rich orange, studded over, as is the olive-coloured back, with round black spots. His tail in spring time is bordered with a fin-like expansion, and is often tipped with bright red and violet. The female deposits her eggs on the leaves of aquatic plants, which she folds up in a curious manner, and glues together as a protection to the soft and shell-less eggs. There is a curious superstition current among the Irish peasantry:—They believe that this Newt has a propensity to jump down their throats, make a lodging in their stomach, and to multiply there in a frightful manner. The remedy is to find a stream running directly south, and to lean over it with the mouth open, when the "efts" will come out, one by one, and plunge into the water!

TAILLESS BATRACHIA (*Anoura*).*

The total absence of the least vestige of a tail, and their short, squat, broad shape, their great heads, huge mouths, and strong muscular limbs, are sufficient to identify Frogs and Toads anywhere, espe-

FIG. 305.—FROG.

* *α*, a, *without* ; *ὀυρά*, oura, *a tail.*

cially as in these particulars they differ so widely from any other member of their class. But these characters apply only to the adult animals; in the tadpole condition, an unscientific observer would scarcely detect any difference between a Frog and a Newt.

The **Frogs** (*Rana*) are too well known to need description. The energetic movements of the Common Frog (*Rana temporaria*) command general admiration. The length of its leaps and its vigorous action in swimming depend on the great development of the hinder limbs. These animals feed on slugs and insects, which they seize by means of their tongue, the arrangement of which is very curious. When at rest the tongue is doubled back upon itself, so that the tip is directed towards the throat—in seizing a fly or beetle it is launched forth like lightning, and as quickly retracted, with the captive prey adhering to its extremity. The accompanying figure of the skeleton of the Frog may be compared with that of the Salamander on a previous page. It will be seen, with many

FIG. 306.—SKELETON OF FROG.

points in common, to present important differences, particularly the small number of joints in the spine, the great size of the pelvis, or bony frame-work at the hinder part, and the enormous development of the hinder limbs, The Frog has no trace of ribs, which in the Newts do exist, though very small.

Frogs are distinguishable from Toads by a row of teeth all round the upper jaw. They feed only on living prey. In winter they bury themselves in the mud, or in holes, and do not eat.

The **Tree Frogs** (*Hyla*) do not differ much from ordinary Frogs, except that the extremity of each of their toes is enlarged and rounded into a sort of viscid pellet, or ball, that enables them to adhere to objects upon which they climb, and to ascend trees. Endowed with great suppleness and agility, Tree-frogs travel very

lightly over the most flexible branches. During the whole summer they live in this manner on trees, pursuing insects, but in winter they retire to the bottom of the water, like ordinary Frogs, and do

FIG. 307.—TREE FROG.

not return again to the humid foliage where they reside, until after they have deposited their eggs. The common Tree-frog (*Rana arboria*) is of an apple-green colour above, and pale beneath, with a black and yellow line along each side.

The **Toads** (*Bufo*) have a thick-set body covered with warts, from which exudes a viscid humour. Their hind legs are not so much elongated as those of Frogs, and they leap badly; in general, they creep rather than walk, and when surprised, instead of taking to flight, they stop suddenly and inflate their body, so as to render it tense and elastic, and cause the skin to pour out a white and acrid fluid. Sometimes they endeavour to defend themselves by biting, but their mouth is quite destitute of teeth. These hideous reptiles generally conceal themselves (in shady humid places, from which they do not go out except at night, or immediately after the warm and abundant rains of summer. Like Frogs, they feed on small mollusks, worms. and living insects, but they are more terrestrial in their habits, They betake themselves in summer to pools and streams, where the females resort to deposit their eggs. In countries where the winter is cold, they pass the season in holes in a benumbed state. Their respiration then becomes extremely limited, and the contact of a very small quantity of air with the skin is sufficient to maintain their existence. When placed in situations where evaporation is very inconsiderable, they can live in this way for a long time. This explains how it is that Toads enclosed in plaster, or shut up in holes

excavated in stones, are often found alive after many months of confinement.

FIG. 308 —TOAD.

The Pipas are still more hideous than the Toads. Their body is more flattened, the head triangular, the eyes very small, their hind

FIG. 309.—PIPAS.

legs short, and their anterior toes split at the end into three or four points. The tongue is entirely wanting. The species best known inhabits the warm and humid parts of South America, and is remarkable on account of the manner in which its young are developed. The male places the eggs on the back of the female, who immediately takes to the water, where her skin swells and forms cells, wherein the young are hatched, and remain until they have completed their metamorphosis; then the mother returns to land.

CHAPTER XXV.

Serpents (*Ophidia*).*

The first order of true Reptiles includes the Serpent tribes,—animals entirely deprived of limbs, and yet endowed with most formidable attributes. Unfur-

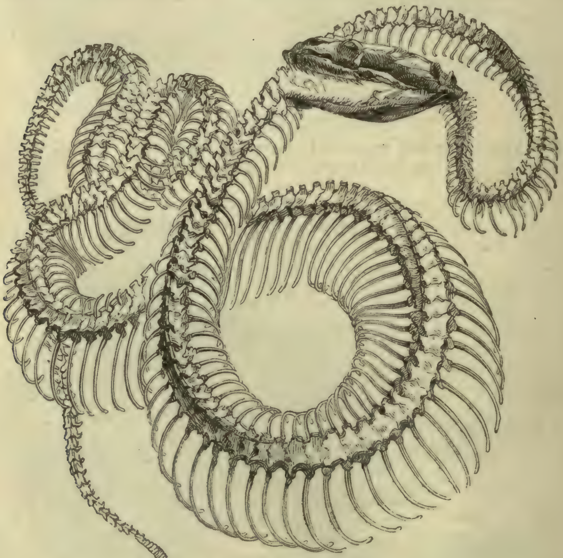

Fig. 310.—SKELETON OF SERPENT.

nished with any apparent means of progression, the scale-clad Serpent makes its way in either element

* ὄφις, ophis, *a serpent*; εἶδος, eidos, *form or shape.*

with equal facility. Destitute of any prehensile members, it seizes and devours the strongest and most active prey, it binds its victims in a living rope, or with a single scratch inflicted by its venomed fangs speedily destroys the stoutest assailant. The Ophidian Reptiles are arranged in five families.

The **Water Serpents** (*Hydrophidæ*),* as their name imports, are aquatic, many living in the sea, and others in fresh water. They are chiefly natives of the East Indies and the Indian seas.

The **Sea** or **Pelagic Serpents** (*Hydrophidia*) are not very numerous in species, thirty-two only being described, but they are extremely abundant as individuals, and unlike the Terrestrial Serpents, are always met with in numbers together; so much is this the case in latitudes where they are common, that their appearance serves to mariners as an indication that they are approaching land. Their body, in order more easily to cleave the waves, becomes slender towards the two extremities, and their tail is so compressed or flattened as to be at once an oar and a rudder. These snakes cannot erect their fangs so much as the Viperine Serpents, and in biting their prey, they retain hold of it with their jaws. Their size varies in different species, from two feet and a half to five feet.

The **Fresh Water Snakes** (*Homalopsina*) † are nearly equal in number to the Marine, about thirty-six species being described. They are almost all natives of intertropical countries, and have been met with in India, China, Java, Borneo, the West Indies, and in the warm parts of North and South America. Many of them attain considerable dimensions, but they rarely exceed four feet in length, though they are as thick as a man's arm. The greater proportion of them are truly aquatic, and appear particularly formed for peopling the immense tracts of fresh water found in the countries they inhabit, which swarm with fishes, that constitute their usual food. They have a peculiar appearance, and most disproportionate shape,—a short, conical, and robust tail, a head exceedingly broad, thick, blunt, and short, covered with plates of irregular and inconstant form, small nostrils, and little eyes directed upwards.

The second family is that of the Venomous Serpents, *par excellence,* the most dreadful of all living creatures. Fortunately there is something more than usually repulsive in their aspect, their thick broad head, their wide jaws, their brilliant eyes, give them an expression of diabolical malignity, and man and beast instinctively recoil from their presence. Their general appearance and phy-

* ὕδωρ, udor, *water;* ὄφις, ophis, *a snake.*

† ὁμαλός, homalos, *smooth;* ὄψις, opsis, *appearance.*

siognomy are so peculiar, and the impression which their look creates is so vivid, that they may, for the most part, be immediately recognised by any one who has ever attentively examined a single species. "Their jaws are generally weak; the under one is provided with a series of sharp-pointed teeth, but the upper jaw is destitute of any, except the moveable poison fangs. The head is extremely broad, flattened on the crown, and heart-shaped or triangular. Instead of being covered by plates, as in the harmless races, it is clothed in scales similar to those of the

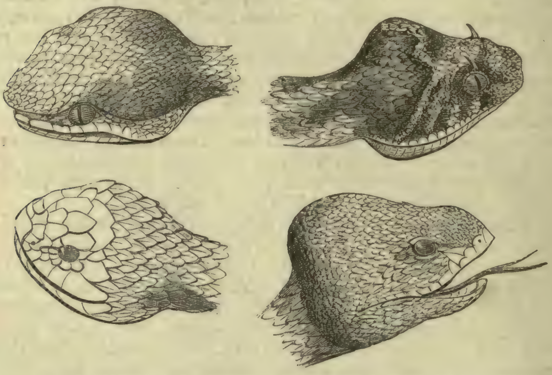

FIG. 311.—HEADS OF POISONOUS SNAKES OF DIFFERENT GENERA.

back. Their eyes are small, have a vertical pupil, are deep sunk in the sides of the head, and overshadowed by the projecting plates of the eyebrow. The upper lip is swollen, and hangs down in order to conceal the long fangs. In form they are heavy and squat, the body being pretty thick in the middle, somewhat compressed; the back slightly keeled, covered with rough keeled scales, while the belly is covered with broad band-like shields or scuta. The tail is short, conical, and thick, but never blunt at the tip.

"Their manners, habits, and method of killing their prey are very characteristic. Their dull, heavy dis-

position, their slow mode of progression, the extreme sluggishness of all their movements, would naturally render their pursuit of active animals unavailing; but gifted with the utmost patience, they calmly wait till chance brings within their reach the creatures destined for their food. When these approach, or when disturbed by an enemy, they display their formidable powers. They raise their heads erect, open their mouth so wide, that their jaws form an obtuse angle, they project their fangs, their body uncoils like a loosened spring, and the serpent, aiding the sudden assault by resting upon its tail, darts at a single bound upon its victim to inflict the fatal wound,"

"And hurls at once its venom and its length."

The art of the chemist has not succeeded in extracting from the most deadly substances a poison so potent as that with which they are gifted. Its effect is almost instantaneous, from thirty seconds to two minutes is the brief time required for its operation, so fearful, so merciful is its mortal virulence when employed against the small animals that constitute the ordinary food of these reptiles. It is in tropical climates that the poisonous serpents thrive. They swarm in Surinam, in French Guiana, in Peru, in Brazil; and in the neighbourhood of the lower Orinoco they are so abundant, that when the natives set fire to the brushwood and grass with which the country is covered, whole armies of formidable species sally forth in crowded ranks, to the number of thousands at a time, putting all to flight before them. In cold countries only a few are to be found in a large extent of territory—they grow scarce as we go north, and totally disappear in the polar regions.

In the **Venomous Serpents** the teeth of the upper jaw are generally deficient, or very small, with the exception of two of large size, which constitute, perhaps, the most terrible weapons met with in the animal creation. These poison teeth, placed one on each side,

are attached to moveable bones (Fig. 312). When not in use, they are laid flat upon the roof of the mouth, where they are covered by a fold of the gums; but when the animal is irritated or about to strike its prey, they are plucked up from their concealment and stand out like two lancets. Each fang is traversed by a canal, not, as it is generally described, excavated in the substance of the tooth, but formed by bending, as it were, the tooth upon itself, so as to enclose a narrow channel through which the poison flows. The glands in which the poison is elaborated (Fig. 313) occupy a considerable space on each side of the head. The substance of these organs

FIG 312.—POISON-FANGS.

FIG. 313.—POISON GLAND.

is spongy, and composed of cells that communicate with the poison-duct, whereby the venom is conveyed to the base of the fang, and instilled into the wound inflicted by these fatal instruments.

The **Rattle-snakes** (*Crotalus*)* owe their name to a singular apparatus which terminates the tail, and which distinguishes them from all other Serpents. It consists of a series of horny scales, loosely fitting into each other like a nest of boxes, which vibrate and sound when the animal moves. Even while they are at rest this instrument is shaken with extreme rapidity, and thus produces a noise sufficiently loud to be heard at a distance of many yards.

Rattle-snakes attain a length of five or six feet, and even more. They inhabit America, and are dreaded on account of the virulence of their poison. In general, they do not bite except when provoked,

* *κρόταλον*, crotalon, *a rattle or castanet.*

and they rarely attack animals too large for them to swallow. Notwithstanding that their food consists of birds, squirrels, &c., they do not climb trees. These serpents usually keep themselves coiled spirally near a watering place frequented by small mammals. There

FIG. 314 —RATTLE-SNAKE.

they patiently wait until some victim presents itself, and when within reach they spring upon it with the rapidity of lightning. There are many species of these terrible animals. The negroes eat their flesh.

The **Fer-de-lance** (*Craspedocephalus* lanceolatus*) is one of the most deadly serpents of the West Indies, where it principally haunts the plantations of sugar-cane. Concealing themselves under the long leaves wherewith the earth is strewn, they carry on a constant warfare against lizards, small birds, and rats. The latter animal forms the chief article of their food. When at rest this snake coils itself up in four circles of equal diameter one above another, under the last of which is placed the tail; the head, terminating the upper extremity of the coil, is a little reared and drawn backward. From this position it throws itself with the rapidity of an arrow upon its victim.

The **Horned Vipers** (*Cerastes*) found in the burning sands of Africa; the Hooded Snakes (*Naja*), common in India; the Puff-Adder (*Clotho*), of the Cape of Good Hope, and hosts of others

* *κράσπεδον*, craspedon, *an edge or border*; *κεφαλή*, cephale, *the head.*

might be mentioned whose names are familiarized to us by the accounts of travellers.

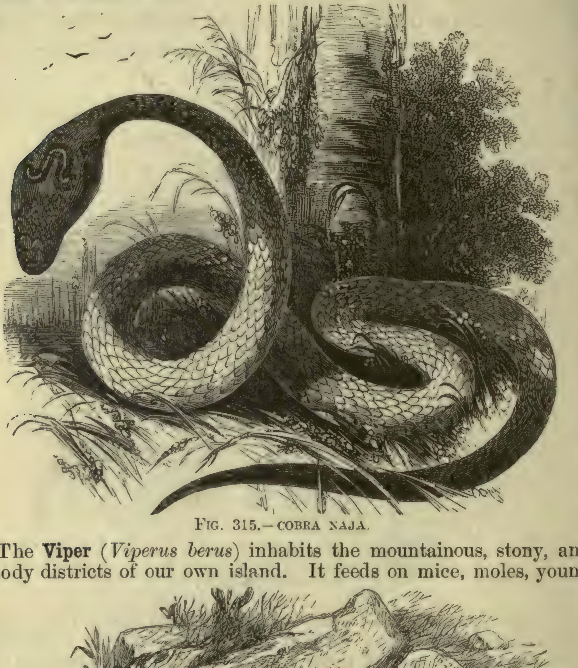

FIG. 315.—COBRA NAJA.

The **Viper** (*Viperus berus*) inhabits the mountainous, stony, and woody districts of our own island. It feeds on mice, moles, young

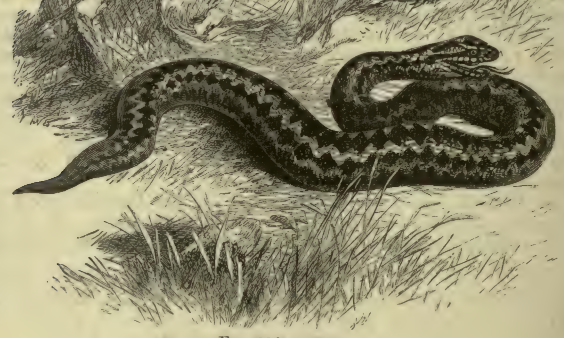

FIG. 316.—VIPER.

birds, reptiles, and even insects and worms. During the cold season these Reptiles remain benumbed in holes, where several are often found entwined together. They are most frequently seen on the first fine days of spring, warming themselves in the sunshine; but when the weather becomes very hot, they are rarely to be met with. The bite of the Viper is very dangerous.

The family of **Boas** (*Boidæ*) contains a considerable number of species, upwards of forty being described in the catalogue of the British Museum. They are, generally speaking, the largest of all the Serpent tribe, and are characterized by several distinctive marks. The greater number of them have a prehensile tail, which, though short, is excellently fitted for grasping the branches of trees. They possess rudimentary hind extremities, which are developed under the skin. These consist of several small bones,

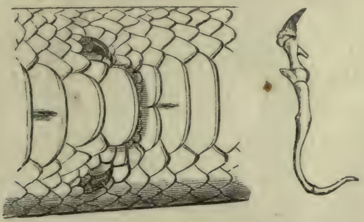

FIG. 317.—VENT AND HOOK OF BOA.

terminated by a horny spur, not unlike the spur of a fowl in miniature; these little claws project externally a little in front of the vent (Fig. 317). Their body is well adapted for twisting and twining round other objects, and the scales that cover it are small and numerous.

The **Boa Constrictor** has the upper jaws and palate bones lined with teeth, all of which are very sharp and pointed backwards. Each side of the lower jaw is likewise armed with teeth, all directed towards the throat. It must be evident, from a mere inspection of these teeth, that they can be of little use in holding, much less in destroying such strong and large animals as the Boa devours, and upon a little reflection we shall find that they are intended for a very different purpose. These serpents are said to watch in the forests, and especially near the drinking-places of rivers, there hanging from a tree, until some quadruped passes within range.

On its approach, the Boa darts upon its prey and more swiftly than the eye can follow, encircles it in voluminous folds. The Boa thus kills its victims by coiling its lengthy body round their chest, and then by strong muscular contraction, compressing the ribs so firmly that respiration is prevented, and the animal so seized speedily perishes from suffocation. But having succeeded in extinguishing life, the most difficult task still remains to be accomplished. How

FIG. 318.—BOA CONSTRICTOR WATCHING FOR PREY.

is the serpent, utterly destitute as it is of all external limbs, to force down its throat an animal many times thicker than its own body? The mode adopted is as follows:—Having relaxed the dreadful embrace, it once more winds itself round the slain animal, and

commences with the head, which by main force it thrusts into its mouth, the jaws becoming widely separated, so that the throat is stretched enormously as the food is forced into it. Deglutition is here a very lengthy and laborious process, and was there not some special contrivance to guard against such an accident, no sooner were the efforts of the snake relaxed in the slightest degree, than the muscles of the throat and jaws being in an extreme state of tension, would force out of the mouth what had already been partially swallowed. To provide against this, the teeth are by

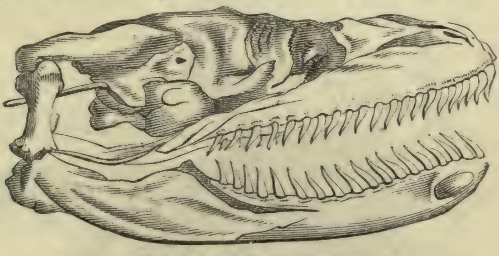

FIG. 319.—SKULL OF PYTHON.

their position converted into a sort of valve. Pointing backwards as they do, they permit the bulky food to pass down towards the throat, but at the same time their sharp points efficiently prevent it from being pushed back again in the opposite direction.

"facilis descensus Averni
"Sed revocare gradum, superas que evadere ad auras
"Hoc opus hic labor est."

The largest of all the Boa family, and perhaps the largest of the Serpent race, is

The **Anaconda** (*Eunectes murinus*), found only on the American continent. It is to this species that we must refer the greater number of the highly-exaggerated tales of travellers relative to the enormous size, ferocious habits, and extraordinary voracity of the monstrous serpents of the new world. Still it is quite formidable enough; one of its provincial names, *El Traga Venado*, or the Deer-swallower, sufficiently indicates the idea entertained by the Indians relative to the nature of its food.

The **Harmless Snakes** (*Colubridæ*) form a very ex-

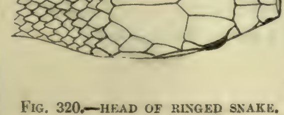

FIG. 320.—HEAD OF RINGED SNAKE.

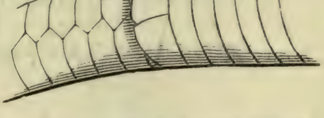

FIG. 321.—BELLY AND TAIL-SHIELDS.

tensive family, recognisable by having the head small and covered with broad plates, and the tail conical and tapering; they are quite destitute of poison teeth. Of these not fewer than three hundred and forty different species have been described.

The **Common Ringed Snake** (*Coluber natrix*) affords a good example of the group. It has broad flat plates on the head, and

FIG. 322.—COMMON RINGED SNAKE.

the belly is shod as it were with a single series of wide parallel horny shields, placed transversely; beneath the tail, these are disposed in a double series (Fig. 321).

The fifth family of Serpents (*Amphisbænidæ*) contains

The **Double Walkers** (*Amphisbæna*),* so called because it is difficult to make either head or tail of them, seeing that they progress equally well with either end foremost. They have much resemblance to the Slow-worms delineated in the next figure, feed chiefly upon ants and other insects, and are perfectly harmless. The species are few, and abound in the tropical parts of both hemispheres.

* ἀμφίς, amphis, *both ways*; βάινω, baino, *to go*.

LIZARDS (*Sauria*).*

The Saurian Reptiles might almost be described as serpents supported upon legs; indeed, in some of the genera the resemblance to serpents is so great that they might easily be mistaken for those animals. In general, however, the legs are sufficiently developed to be used as the principal instruments of locomotion; They are then four in number, and the toes are armed with claws. Their skin is covered either with scales or with granulations; but in other respects they are most variously constructed, as will be seen by inspecting the tabular view of their classification in the following page:—

* σαῦρος, sauros, *a lizard*.

CLASSIFICATION OF SAURIAN REPTILES.

SAURIANS.

- Having four toes on the hind and five on the fore-feet; tail compressed; tongue not extensile, and the heart with four cavities . . . . **CROCODILIANS.**
- In general having five toes, and always the same number on the anterior and posterior limbs. Heart with but three cavities . . .
  - Tongue very extensile .
    - Bifid at the end, toes free, tail not prehensile . . . . . **LACERTIANS.**
    - Terminated by a fleshy cylinder; toes united in two opposable parcels; tail prehensile . . **CHAMELEONIANS.**
  - Tongue not extensile .
    - Limbs long, body neither fusiform nor vermiform
      - Toes unequal and not widened at the end; body light **IGUANIANS.**
      - Toes equal, almost always widened at the end in form of a disk or fan; body squat . . **GECKOTIANS.**
    - Limbs in general very short, and sometimes only two in number. **SCINCOIDIANS.**

The habits of these various families are very diverse. Some, as the Crocodiles, inhabit lakes and

rivers. Others, as the Iguanas, live among the foliage of trees. Some, as the Dragons, perform a sort of flight like that of the flying squirrels. The lizards delight to bask in the genial rays of the sun on exposed sandy banks; others conceal themselves in humid forests, beneath stones and rotten logs. Some crawl with slow and languid efforts; others run with a celerity that the eye can scarcely follow. Though found in almost all countries, the fervent sun of the tropics seems most favourable to their existence, and it is more especially in such regions as have a moist as well as a hot atmosphere that they abound.

The ribs of the Saurians are moveable, and can be raised or depressed for the purpose of respiration. Their eggs have an envelope more or less hard, and the young issue forth in the form that they always retain.

Their mouth is invariably furnished with teeth, and with few exceptions their toes have claws.

The transition from serpents to lizards is happily exemplified by a pretty little animal, common enough in this country, called

The **Slow-worm** (*Anguis fragilis*), the appearance of which is

FIG. 323 — SLOW-WORM.

thoroughly snake-like; its body is very long and slender, and it has not the slightest appearance of limbs. Yet it is very closely allied to the Lizards, as its internal structure clearly shows. The bones of the *pelvis*, or arch to which the hinder limbs are attached, are found to exist in a rudimentary state, although no outward indication of limbs appears. If this little creature is laid hold of or alarmed, it contracts its body so forcibly as to become perfectly stiff, and then it will break in two with the slightest blow, or attempt to bend it. We, therefore, at once perceive the propriety of one of its Latin appellations, that of *fragilis* (brittle). The Slow-worm is not only perfectly harmless, but extremely useful, its principal food consisting of slugs, the greatest enemies of the agriculturist.

In the **Glass Snake** of North America the condition of the limbs is equally rudimentary. Other species display, as it were, links in a curious chain of gradations; some have two minute feet in front and none behind; others, as the **Sheltopusik** (*Pseudopus*), have only sproutings of the hinder pair. Some have both pairs, but small and weak, set very far apart on the lengthened body, and destitute of toes. In others, they become gradually more developed, until we find them at length completely formed, as in

The **True Lizards** (*Lacerta*), remarkable for the activity of their movements. Of these we have two native species.

The **Common**, or **Viviparous Lizard** (*Zootoca*), so called because

FIG. 324.—COMMON LIZARD.

instead of depositing her eggs in the sand to be matured by the warmth of the sun, as other lizards, the female of this species retains them until the young are hatched, and thus they are produced alive.

The **Sand Lizards** (*Lacerta agilis*) are remarkable for the activity of their movements. Every one must have remarked with what rapidity they run from one place to another, and how they can cling to walls and rocks by means of their long and crooked claws. The food of these lizards consists chiefly of insects. They are timid, harmless animals, darting away on the slightest alarm, and concealing themselves in some convenient retreat.

The **Flying Lizards** (*Draco volans*) have their hinder pairs of ribs prolonged to such an extent that they support a broad expansion of

FIG. 325.—DRACO VOLANS.

the skin, so spread out from either side as to perform the office of a parachute, thus enabling these little creatures to spring from tree to tree with wonderful activity.

The **Scinks** (*Scincidæ*) have the legs small, feeble, and set far apart; the body is covered with overlapping scales. The tongue is fleshy, notched, and scaly. They are harmless, commonly feeding in insects; but

The **Gallywasp** of the West Indies (*Celestus occiduus*) feeds on fruits.

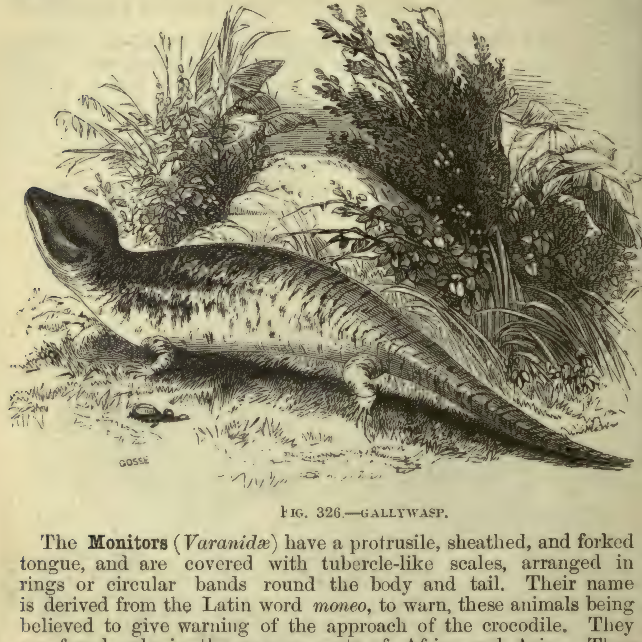

FIG. 326.—GALLYWASP.

The **Monitors** (*Varanidæ*) have a protrusile, sheathed, and forked tongue, and are covered with tubercle-like scales, arranged in rings or circular bands round the body and tail. Their name is derived from the Latin word *moneo*, to warn, these animals being believed to give warning of the approach of the crocodile. They are found only in the warmer parts of Africa and Asia. They live near the banks of rivers, and some are aquatic in their habits. They often devour the eggs of crocodiles and aquatic birds, even small fishes, lizards, and tortoises fall victims to their voracity.

The **Guanas** (*Iguanæ*) belong to the New World. Their teeth are of remarkable structure, and crenated round the edge. Most of them live on trees, which they climb by means of their long hooked claws, in search of fruits and leaves, that form their principal sustenance. The flesh of the common Guana is in good estimation as an article of food.

The **Geckos** (*Gecko*). All the preceding families are active by day, but the Geckos are nocturnal in their habits. They are rather clumsy and stoutly built, of dull lurid colours, with great eyes, the pupils of which contract to a line, like those of the cat. The structure of their toes is very remarkable; their under-surface is expanded into broad flaps, furnished with parallel plates that overlap each other (Fig. 327); by means of these they are enabled to cling to perpendicular surfaces, or even to walk suspended from the ceiling like the house-fly. They utter unmusical cries by night, which have been thought to resemble the word geeko, whence their name.

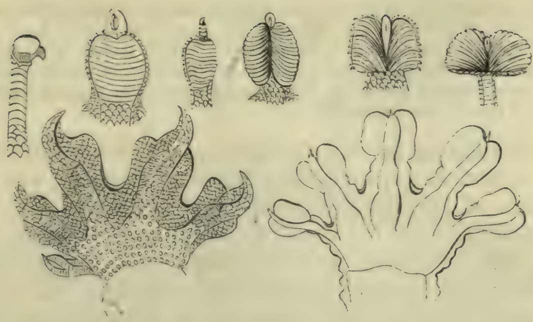

FIG. 327.—FEET OF GECKOS.

The **Chameleons** (*Chameleo*) are the most remarkable of reptiles. Their toes, five in number, are divided into two groups that oppose each other, as in the foot of a parrot, a provision which enables them to grasp firmly the boughs of the trees upon which they live. They

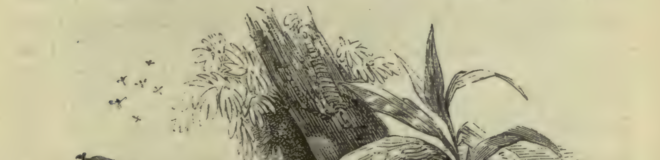

FIG. 328.—CHAMELEON.

are dull, slow animals, languid and heavy in their movements, and often remaining in the same position, for hours together, basking in the sun. The only part that moves with quickness is the tongue. The food of the Chameleon consists of insects, and it will remain

motionless, stationed upon a branch, until the unconscious prey comes within reach, when in a moment the tongue is darted forth, and the insect is caught and swallowed. Their power of changing colour is wonderful, accurately imitating the tints of the leaves and branches around them; so that their presence is not discoverable except upon close inspection.

The **Crocodiles** (*Crocodilus*), sometimes classed as a distinct order, under the name of **Loricata,** are the giants of the Reptile race, some of them attaining the length of twenty-five feet; and as they are strong, ferocious, and cunning, they may rank among the most formidable animals. In their general form they agree with the Lizards, but they are distinguished by several important characters.

Of these, the most tangible and obvious is that the whole back part of the neck, body, and tail is clad with distinct series of bony plates embedded, as it were, in the substance of the skin, and covered externally with a thick cuticle. These dermal bones are exceedingly strong, and they altogether form a panoply of defence, capable of resisting the attacks of the most powerful enemies. The bones of the head in the Crocodile are more consolidated than those of most reptiles; the lower jaw is prolonged behind the base of the skull, and this structure causes the upper jaw to seem moveable. There is in each jaw a single row of teeth, which are conical in form. A cavity at the root of each tooth serves as a case or sheath for the germ of the tooth destined to replace it; and each being thus gradually pushed out by a successor ready to supply its place, the mouth of the Crocodiles presents at all ages its formidable array of pointed teeth in undiminished number. The tongue is flat, and free only at the very edge, so that these unwieldy animals have often been described as destitute of a tongue. The face has no lips, hence the long and close array of grinning teeth is always visible, imparting a very repulsive aspect to the

FIG. 329.—TOOTH OF CROCODILE.

countenance. The strong bony scales forming their coat of mail are frequently ridged, and those of the tail are elevated into a deeply notched or saw-like crest, which at the basal part is double.

FIG. 33?.—CROCODILE.

CHELONIAN* REPTILES.

The Chelonian Reptiles are distinguishable at the first glance by the double buckler wherein their body is enclosed, leaving only the head, neck, tail, and four feet moveable.

The upper buckler, named the *carapax*, or back-plate, is formed by the ribs, eight pairs in number, which are widened, united together, and solidly fixed to the back-bone. The lower buckler, termed *plastron*, or breast-plate, is formed of pieces that represent the sternum, nine in number. A framework,

* χελώνη, chelone. *a tortoise.*

usually composed of bony pieces, surrounds the carapax, and connects all the ribs together. The vertebræ of the neck and tail only are moveable, and the bones of the shoulder and pelvis are

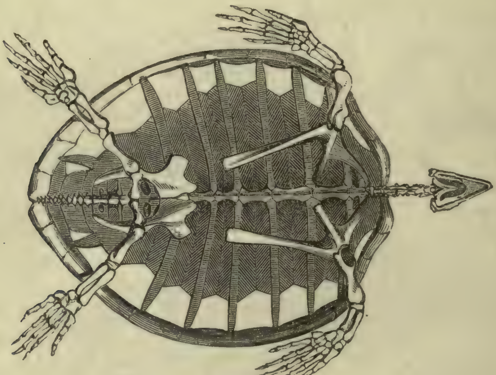

FIG. 331.—SKELETON OF TURTLE.

literally situated inside the body. The outer surfaces of the carapax and plastron are covered with a series of horny or sometimes leathery plates, of regular angular forms, closely fitted to each other. The jaws are clothed in horn, like the beak of a bird, which they much resemble, both in appearance and action. The eggs of the Chelonians are covered, like those of birds, with a hard, brittle, white shell, and are deposited by the female in the warm sand, where they are hidden from observation and left to be hatched by the heat of the sun.

Tortoises possess amazing tenacity of life: some have been known to move for many weeks after decapitation. Very little nourishment is necessary for them, and they can pass entire months, without eating.

The Chelonian Reptiles may all be arranged in four principal families, according to the following Table:—

CHELONIANS, having the feet	Large, truncate at the end and formed for walking only, and having the toes united into a common mass as far as the nails		**LAND-TORTOISES.**
	Flattened and provided with distinct toes, simply united by a palmate membrane, which is . .	Incomplete, carapax furnished with scales	**POND-TORTOISES.**
		Complete, carapax covered with a soft skin . . .	**RIVER TORTOISES.**
	Flattened, in the form of large swimming paddles, and not having the toes externally distinct		**SEA-TORTOISES, OR TURTLES.**

The **Turtles** (*Chelonidæ*) are very remarkable on account of the structure of their limbs. The feet, though the toes are composed of distinct pieces, and armed with sharp claws, are changed into flat depressed fins, only fitted for swimming, an act which they per-

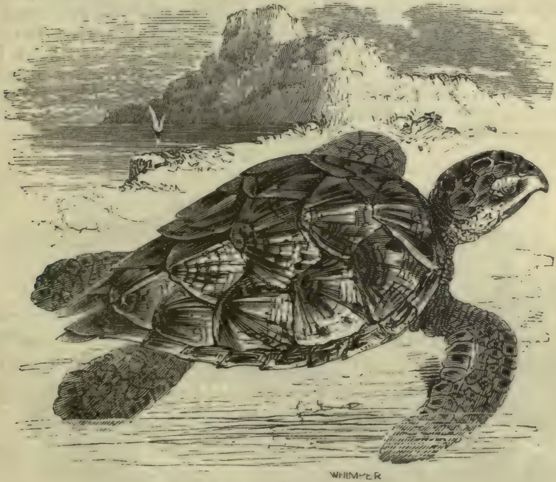

FIG. 332.—HAWKSBILL TURTLE.

form with great vigour and celerity. The fore legs are much longer and larger than the hinder ones, and are not retractile within the shell; their carapax is generally heart-shaped and exceedingly flattened, a form well adapted to admit of rapid movement through the water.

Turtles feed principally upon marine plants, and only leave the sea to lay their eggs. They swim with great facility, and are sometimes met with several hundred miles from land, floating on the

surface of the ocean. They appear to be able to sleep in this way, and they also dive very well. At the laying season they leave their habitual haunts and resort to the shores of some desert island to deposit their eggs in holes which they dig in the sand. During the night they drag themselves on to the beach beyond the line of high tide, and with their fore-fins excavate a cavity about two feet deep, wherein they deposit their eggs in regular ranges, and cover them with sand so carefully as scarcely to leave the smallest trace of their labour. This operation accomplished, they return to the sea. The number of their eggs is very considerable, sometimes as many as two hundred, and the laying is repeated two or three times a year. In about fifteen or twenty days, the eggs are hatched, and the young, as yet quite soft and shell-less, immediately make for the water; but, before reaching it, they often become the prey of carnivorous birds, that seem to await the moment of their birth to feast upon them. They have also to dread voracious fishes and crocodiles, so that comparatively few escape from their numerous enemies.

The tortoise-shell, so much valued on account of its high polish, semi-transparency, and richly-clouded colours, is obtained from the plates covering the back of the Hawks-bill Turtle (*Chelone imbricata*), of which a figure is appended (Fig. 332). The flesh of this species is not valued; but there is another (*Chelone mydas*), belonging to the same family, so highly esteemed for the delicacy of its flavour, that great numbers are annually imported from the tropics for the sake of the flesh alone. They are packed one upon another in casks of sea-water, which is changed daily. Both of these species have been taken on the Bristol coast; but such an occurrence can only be considered rare and accidental.

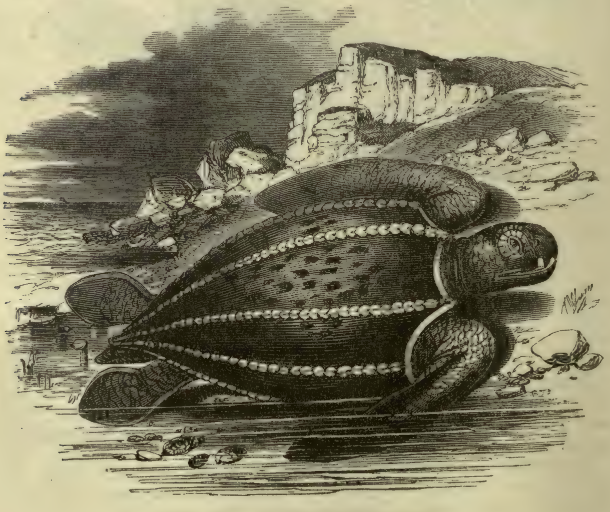

FIG. 333. - LEATHER-BACKED TURTLE.

The **Leather-backed Turtle** (*Sphargis*) (Fig. 333), instead of horny plates, is covered with a leathery skin, marked by several ridges running lengthways down the back. These animals are amongst the bulkiest of the race, and have been known to measure nine or ten feet. They have a remarkable cry, and when caught in the net utter a loud roaring sound, whence they derive their name *Sphargis*, from the Greek (*σφαραγίζω, spharagizo*), which means to move with a noise.

In the great rivers and lakes of both hemispheres there are some large and ferocious creatures, known as—

The **Soft Tortoises** (*Trionyx*). These have no horny shell, but are covered by a soft skin, occupying the centre of the back, and surrounded by a broad margin of firmer texture (Fig. 334). Their feet are webbed, but three toes of each are furnished with powerful claws, whence their name *Trionyx* (three-clawed). The beak is horny, and

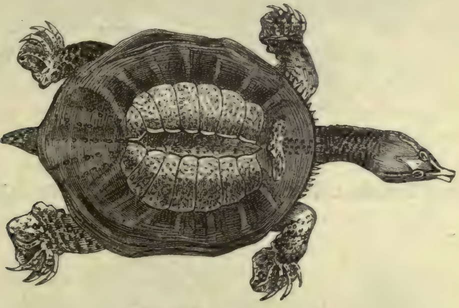

FIG. 334.—SOFT TORTOISE

partly concealed by fleshy lips, and their muzzle is extended into a short proboscis. These animals are eminently carnivorous, and pursue fishes and young crocodiles, which they catch in the water. Notwithstanding the nature of their food, their flesh is esteemed for the table, and hence they are caught with a hook and line. In seizing their food or defending themselves, they dart out their long neck with the sudden rapidity of an arrow. The grasp of their powerful and trenchant beak is sharp and deadly, nor is it relaxed until the part seized is cut out. Indeed, such is their boldness and ferocity, that they are dreaded even by those who fish for them.

The **Marsh Tortoises** (*Emys*) form a very numerous family, including seventy-four out of the one hundred and twenty species known to belong to the order. More than half of them are American. They resemble the common Land Tortoises in their general appearance, but are flatter, and their toes are connected by a web. They inhabit fresh waters, in which they swim with facility, and are often found in stagnant ponds and morasses. They feed on small aquatic animals. Many species are esteemed for the excellence of their flesh. The common European Terrapin (*Terrapene Europæa*)

is taken in great numbers, fattened in cellars, and sold in the markets of Germany.

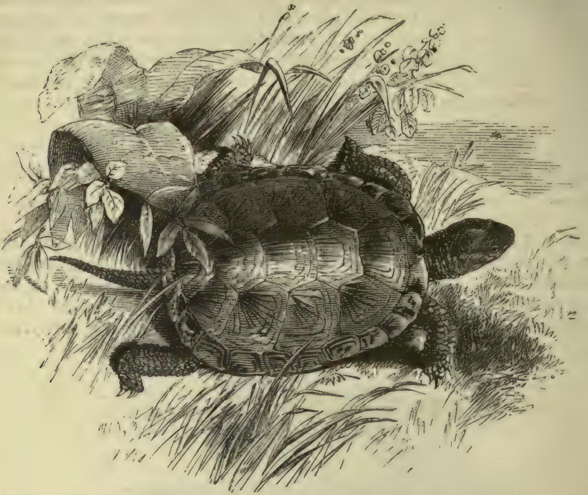

FIG. 335.—EUROPEAN MARSH TORTOISE.

The **Land Tortoises** (*Testudo*) (Fig. 336) are recognized by having

FIG. 336. GALAPAGOS TORTOISE.

their upper shell very high and convex; their limbs are short and pillar-like, appearing as if cut off; they are terminated, however, by horny hoof-like claws. The Land Tortoises live exclusively on vegetables, such as leaves and fruits, do not seek the water, are heavy and slow in their movements, and burrow in the earth in cold weather. They are remarkable for their extreme longevity. In the tropics there are species of great size (as the *Galapagos Tortoise*, represented in our figure); some, indeed, are so heavy that it requires six or eight men to lift them from the ground; one of these will afford two hundred pounds of excellent meat.

CHAPTER XXVI.

Birds (*Aves*).

No department of Nature is left unfurnished with appropriate inhabitants. The inconspicuous air, and those tracts of seeming space, too elevated for human ken, are traversed by multitudes of feathered beings, whose buoyancy and beauty are alike the objects of our admiration. The pointed beak, the gently swelling shoulder, the expansive wings, the tapering tail, the light and bony feet of birds, are all wisely calculated to assist and accelerate their passage through the thin and yielding element. Their bodies are covered with a soft and delicate plumage, so disposed as to protect them from the chilly atmosphere through which they pass. Their wings are made of the lightest materials, and yet the force with which they strike the air is so great as to propel their bodies forward with astonishing velocity, whilst the tail serves the purpose of a rudder to direct their flight. Nor is their internal structure less admirably adapted to their mode of life. The frame-work of their bodies is light and thin, and their muscles equally remarkable for energy and strength. Their blood is hot; and, as it courses through their bodies, imparts intense vitality to every quivering fibre. Their movements are consequently rapid and energetic. The Falcon cleaves

the skies like a thunderbolt, as it stoops upon its quarry, and the Swallow, and the Albatross sweep over geographical degrees in their long sustained peregrinations. The perfection of their respiration is perhaps only second to that of insects: the air they breathe passes, not into their lungs only, but penetrates to the remotest parts of their system, filling their very bones with life, and endowing them with activity and animation adapted to their aërial existence.

No one can have examined the bony scaffolding of the Pelican or the Albatross, without being struck with the lightness of its proportions, when compared with the dimensions of the full-plumed bird, of which it once formed the support—a circumstance that has not failed to arrest the attention even of the muse of poetry:

> "Their slender skeletons,
> So delicately framed and half transparent,
> That I have marvelled how a bird so noble,
> When in his full magnificent attire,
> With pinions wider than the king of Vultures,
> And down elastic thicker than the Swan's,
> Should leave so small a cage of ribs to mark
> Where vigorous life had dwelt a hundred years."

The accompanying engraving represents the skeleton of a Vulture, with the contour of the bird drawn in outline, as it would appear if clothed with flesh and feathers. The principal bones are numbered in the figure, and we will refer to them seriatim, as it is important to be acquainted with their appellations and functions.

The skeleton of a bird is composed of nearly the same bones as that of a quadruped; but their form and disposition are different. The attachment of the head to the spinal column consists but of a single pivot, an arrangement that allows the bird to turn its head so as to look directly backwards. The neck is also very moveable; and as these animals have to collect their food with their beak, the length of their neck is in proportion to the height of their legs, or, in many water-birds, to the depth beneath the sur-

face at which they procure their food. The number of the bones in the neck is consequently very variable: the Swan has twenty-three, and the Sparrows only nine; and their joints are so disposed that the

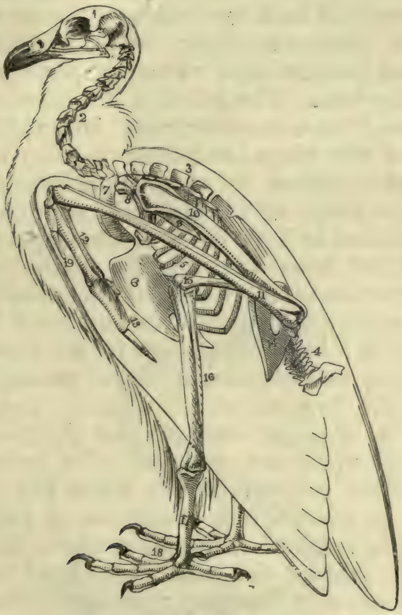

FIG. 337.—SKELETON OF VULTURE.

neck may be bent in the form of the letter S, and consequently elongated or shortened in proportion as the curves are diminished or increased. The trunk of a bird is an admirable piece of mechanism, combining elasticity and strength with the utmost compatible degree of lightness. He is but a bungling mechanic who makes an unnecessary waste of material. The triumph of mechanism is to obtain the greatest possible firmness at the least cost of substance; and whoever examines the chest of a bird will at once acknowledge the transcendent skill evinced in every part of its construction. The

bones of the back (3), which sustain the ribs, are immoveably fixed to each other; the ribs (5), of the lightest structure, are locked together by overlapping plates, while the breast-bone (6) not only constitutes a broad shield or breast-plate, but is furnished with a deep crest or keel, from whence the muscles employed in flight take their origin. Birds having this shield largest and most complete are those that fly the best. The bones of the shoulder (7, 8) are disposed in a manner most favourable to the support of the wings, and the two collar-bones (7) are joined together so as to form but one piece, having the shape of the letter V, an arrangement well calculated to hold the shoulders apart, in spite of the violent force applied in the contrary direction by the exercise of the wings, a force that increases with the energy of the muscles employed in flight. The wing of a bird corresponds to the human arm; and, like it, is composed of three principal parts, the arm, the fore-arm, and the hand. The bone of the arm is of great strength and lightness, being constructed upon the principle of a hollow cane. The fore-arm consists of two bones, the length of which is in relation with the power of flight, while the hand is reduced to a single piece, that serves for the support of the large feathers of the wing; there are also a rudimentary thumb and the vestiges of a third finger.

The legs of a bird are designed for support and for progression; sometimes they are constructed for swimming, and are frequently employed for the purpose of seizing or holding food. The bones of the haunches (14) are of great strength, and solidly fixed to the vertebral column. The thigh-bone (15) is short and directed forward; the leg (16) is strong, and composed of but one bone, while the bones of the foot and instep (17) are represented by a single piece, the length of which determines the height of the bird on its legs. The number of toes (18) varies from five to two; generally, however, there are three

directed forwards and one backwards. In many species there is a peculiar mechanism, by means of which, when perched upon a branch, the weight of their body tends to bend their toes, and consequently to make them closely embrace it in their grasp, an arrangement that permits them to repose in a standing position without any danger of falling while asleep. Perhaps the subjoined engraving will serve to illustrate this very elegant contrivance. The muscle that bends the toes (*a b*) arises, not from the leg, but from the haunch (*a*): becoming suddenly converted into a thin tendon, it passes at *b* in front of the knee-joint, enclosed in a sort of pulley; it then winds round the bone of the leg,

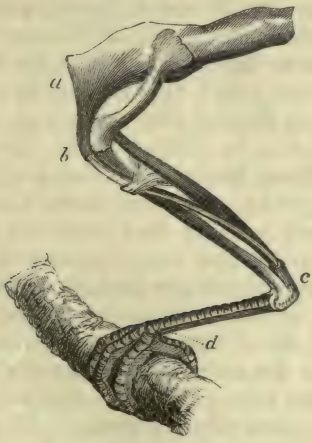

FIG. 338.—LEG OF A BIRD PERCHING.

to the back of the ankle-joint (*b c*), where it likewise passes through a pulley at *c*, hence it proceeds forwards behind the tarsal bone to *d*, where it divides into the sinews that bend the toes. From this arrangement it will be seen that the weight of the bird, by bending the knee-joint (*b*) and the ankle-joint (*c*), puts the muscle (*a*, *b*, *c*, *d*) upon the stretch,

and thus the toes are made to grasp the branch, without any effort.

The feathers with which birds are clothed are structures of admirable contrivance: each feather is composed of a horny stem, hollow at the base, and provided with a plume, or beard, consisting of barbs, which in turn are furnished with barbules. The form of the feathers varies much: some are destitute of any plume, and resemble the quills of the porcupine; others have stiff barbs, with barbules that hook into each other, and thus form an expanse of great strength and lightness; others, again, have both the barbs and barbules long, flexible, and unconnected, rendering them exceedingly soft and light, and there are some composed of simple down. Their colours are infinitely varied, and are often comparable to those of flowers, or the most brilliant gems, in beauty and splendour. Generally, the plumage of the female is not so richly ornamented as that of the male, and it is rare for the young bird to be clothed in the same colours as the adult. Many likewise assume a plumage in the spring altogether different from that of winter. The large stiff feathers that grow on the wings of birds are called the *wing-feathers* or the *pinion-feathers;* they extend the surface of the wings very considerably without adding much to their weight, and convert them into powerful oars, adapted to strike against the air with such force and frequency, that the shock thus produced impels the animal in a direction contrary to the stroke. The ability of a bird to sustain itself in the air, and move through it with rapidity, is in proportion to the expanse of its wings. The feathers that contribute most to the extent of the wing, and are most useful in flight, are those attached to the hand, and consequently farthest from the body. They are always ten in number, and are called *primaries.* The feathers of the fore-arm are called *secondaries,* and those which are attached to the arm (*humerus*), and the

feeblest are the *scapulary.* The *bastard feathers* are those that grow from the thumb, and the *coverts* those that spread over the bases of the quills.

It is evident that the greater the surface of the wings, all things being equal, the greater will be the power of flight; hence it follows that birds with long wings are not only able to fly with greater rapidity than birds with short wings, but they are also able to support themselves for a longer time in the air, because they are not obliged to repeat the movement of these organs so frequently, and therefore do not become so readily fatigued. Thus all birds remarkable for rapid and long-sustained flight, have large wings, while those that have short or moderate wings, compared with the volume of their body, fly less swiftly, and require rest more frequently. The feathers of the tail likewise assist in flight, and are used as a rudder. They are usually twelve in number, and are called the *tail-feathers:* the name of *tail-coverts* is given to those feathers that cover their base.

Birds, instead of teeth, are provided with a strong horny beak; their aliment is generally swallowed without being divided; on this account most birds are provided with a *crop* or pouch, wherein the food is lodged, and with a gizzard or muscular apparatus, lined with a thick, insensible skin, that serves to grind and comminute the food. In granivorous birds the walls of this gizzard are very thick and strong, but in birds of prey, and more especially in such as feed upon fish, it is thin and membranous.

Birds, like reptiles and fishes, are **Oviparous**; that is, they lay eggs, from which the young are hatched, and their eggs are always covered with a hard calcareous shell. To secure the maturation of the enclosed young it is necessary that the eggs should be kept at a certain degree of heat. In very warm climates the heat of the sun is sometimes sufficient, but in most cases one or both parents maintain the necessary temperature by *sitting* or *incubation.*

The time required for the development of the young varies in different races; but it is the same in all birds of the same species. Thus, it is from forty to forty-five days for swans, twenty-five days for ducks, twenty-one days for hens, from twelve to fifteen days for domesticated canaries, and only twelve days for the humming bird.

Almost all birds construct a *nest* to receive their eggs and serve as a dwelling for their progeny, which, during the early period of life, are unprovided with feathers, extremely delicate, and incapable of feeding themselves. Generally, there is displayed in these structures an art, an ingenuity, and an elegance well calculated to excite our admiration. All the successive generations build nests exactly alike, even under circumstances precluding the possibility of their receiving instruction from their parents. A wonderful instinct guides them, and induces them to take many precautions, the utility of which they cannot be supposed to anticipate or appreciate before hand.

The classification of the Feathered tribes is founded chiefly upon the modifications that occur in their beak and feet, the instruments whereby they obtain their food. According to the characters thus afforded, they are divided into seven Orders, as in the following Table:—

BIRDS.	*Terrestrial*, feet not formed for swimming or wading .	Talons very strong, armed with pointed, hooked nails; beak, hooked and sharp			**RAPTORES.** OR **ACCIPITRES.**
		Toes feeble and not armed with sharp hooked nails . .	Beak generally pointed, not hooked . . .	A single toe directed backwards and three forwards	**PASSERES.**
			Wings generally long; body erect . . .	Two toes directed forwards and two backwards	**SCANSORES.**
			Superior mandible, arched or vaulted nostrils partly covered by a soft inflated scale; gait heavy; wings short		**GALLINACEÆ.**
			Wings rudimentary; legs adapted for running .		**CURSORES**
	Aquatic, feet formed for	*Wading*; legs very long and their lower part naked			**GRALLATORES.**
		Swimming, toes webbed; legs short, and placed far back			**PALMIPEDES.**

FIRST ORDER. BIRDS OF PREY.

RAPTORES * OR ACCIPITRES.†

The Raptorial Birds are at once recognized by their beak, which is hooked and terminated by a sharp point bent downwards, and by their feet being very strong and armed with formidable talons.

They are divided into the **Diurnal**, or those that fly by day, and the **Nocturnal**, or those that fly only by night.

FAMILY OF DIURNAL BIRDS OF PREY.

FIG. 339.—BEAK OF FALCON.

At the head of this rapacious tribe may be placed

The **Eagles** (*Aquila*), distinguished by having their legs feathered to the roots of their toes, and their wings reaching to the extremity of their tail. Their vision is wonderfully extensive, and they are said to be able to look at the unclouded sun. These birds are remarkable for the nobleness of their bearing and for their daring courage. They are endowed with powerful limbs, are fond of carnage, and, in general, prefer attacking animals of considerable size. It is only when pressed by hunger that they assail small birds, and will not eat carrion even when in a state of absolute want. Eagles

* Raptor, *a seizer or snatcher.*

† Accipiter, *a hawk*, from accipio, *to take by force.*

build their nest upon the flat surface afforded by some projecting rock, or on a platform of some lofty mountain. Its dimensions are very considerable, and every year contributes to its increase, for it is rare for these birds to abandon their first monument of parental tenderness. Those that leave it return periodically to lay their eggs.

FIG. 340.—FOOT OF EAGLE.

Their nest is frequently composed of such large pieces of wood, that it would be difficult to believe they were ever carried by birds did we not know the extraordinary strength of their limbs. The pieces are so arranged as not to yield readily to the force of the wind, and they support boughs, forming a solid habitation called an eyry. Those species that in the construction of their nests employ only rushes and reeds, accumulate them in great quantities, and fix them so firmly to the platform, that rains or storms seldom cause their destruction. While the female is detained in the eyry by the incubation of her eggs, the male hunts alone, and as it is at the season when game begins to abound, he easily provides for his own subsistence as well as for that of his companion. Eagles live on wild mountains, and ordinarily build their nests on the highest and most precipitous rocks. The duration of incubation is about thirty days.

The **Golden Eagle** (*Aquila chrysaëtas*) is one of the noblest of the feathered inhabitants of the British Isles. He is of large size, his countenance and aspect are grand, and his movements majestic. Whether viewed as he sits in awful solitude on the edge of some lofty crag, or sailing on broadly-expanded pinions above the clouds, he seems to feel himself the monarch of the scene around.

FIG. 341.—GOLDEN EAGLE.

The **Fisher Eagles** (*Halietus*) keep near the margin of the sea, and live principally upon fish.

The **Great Harpy of America** (*Falco harpyia*) is superior in size to the Common Eagle. Of all birds, this possesses the most terrific beak and claws. Such is its strength, that it is said to have cleft a man's skull with its beak ; its ordinary food is the Sloth, and it often carries off fawns.

The **Falcons** (*Falco*) are remarkable on account of their projecting eyebrows, which make the eyes appear as if deeply sunk in the head, and give to the physiognomy an appearance altogether different from that of the Vultures. They have a lofty, rapid, sustained flight ; their sense of sight is more extended and clearer than that of any other animal, enabling them to perceive the smallest prey, when they themselves are out of sight. Most of them feed on the flesh of victims newly killed by their own talons, but when pressed by hunger, they do not refuse dead animals. Instead of eating food on the spot as Vultures do, they bear it off to their eyry. The largest species attack quadrupeds and birds, others feed on reptiles, some live on fishes, and others are entirely insectivorous. They all seize their prey with their feet. Some, as the Falcon and the Kite, precipitate themselves perpendicularly upon their game ; others (the Buzzards and the Gos-hawks) attack obliquely or sideways. They are generally silent, and very difficult to tame ; but some of them are trained to hunt on the wing.

FIG. 342.—PEREGRINE FALCON.

The **Vultures** (*Vultur*). These birds have a disagreeable aspect and tainted odour; they are cowardly, and prefer the most putrid carrion to living prey; and in order to preserve cleanliness while engaged in their filthy banquet, by a wise provision, their head and neck are denuded of feathers. The power of their talons does not correspond with their size, and they make use of their beak rather than of their claws. They are extremely voracious; but after they have been completely satiated, they can wait a long time for an opportunity of feeding again. Their sense of smell is acute, and enables them to perceive at immense distances the remains of dead animals, which they seek as food. In hot climates, these birds are very useful: they serve to cleanse the streets from putrescent substances, and may be seen parading the towns in little bands in search of carrion. Vultures live in pairs; they build their nests on inaccessible rocks, and construct them of pieces of wood, joined together by a sort of mortar. Their young, when born, are covered with down, and are fed with half-digested food, which is disgorged by their parents before them.

The **Griffons** (*Gypaëtos*), in their conformation and habits, very closely resemble the Vultures; but they have their head and neck almost entirely covered with feathers. To this tribe belongs the *Lämmer Geyer*, the largest bird of prey found on the eastern continent, the higher mountain chains of which it inhabits. It attacks

lambs, goats, and chamois. Generally it endeavours to make its victims throw themselves from precipitous rocks, and devours them after they have been killed by their fall—hence it was called by the Romans **Ossifraga**, or the *bone-breaker*.

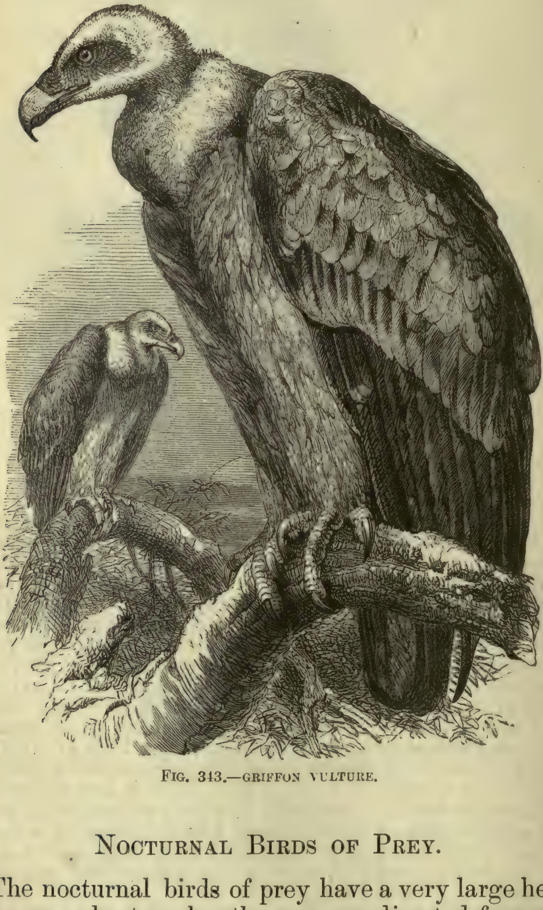

FIG. 343.—GRIFFON VULTURE.

NOCTURNAL BIRDS OF PREY.

The nocturnal birds of prey have a very large head and a very short neck ; the eyes are directed forwards and surrounded by a circle of fringed feathers. The pupil of the eye is large, and the sight imperfect. The external toe can be directed forwards or back-

wards at will. Their wings are not strong, and the wing-feathers have soft barbs, covered with a sort of down. These birds are often designated under the collective name of

The **Owls** (*Strix*). They are blinded by broad day, and only see well in the twilight or at night when it is not very dark, the time they choose for hunting; and as their silky feathers enable them to fly without noise, it is then very easy for them to pounce upon birds

FIG. 344.—BARN OWL.

and small quadrupeds. There are some species that pursue their prey in the day-time; but during this period they generally retire into hollow trees or rents in walls; sometimes they lie flat upon the branches of trees, and then all the little birds of which they are the terror by twilight, come out to insult them. During the night they often utter plaintive cries, regarded by the vulgar as unfortunate omens. In reality, these birds are more useful than injurious, on account of the number of small rats and mice that they destroy. Doubtless their large head and their habitual tranquillity obtained for them the reputation for wisdom, which they enjoyed among the ancients.

Second Order. Passerine Birds.

Passerinæ.*

This Order includes all birds that are neither swimmers, waders, climbers, rapacious, nor yet gallinaceous; that is, it contains all birds that are not assignable to any of the other orders. Its characteristics, therefore, are purely negative; yet, although we cannot unite all the species that belong to it under a common description, they nevertheless resemble each other in the totality or aggregate of their structure. The Passerine tribes have neither the violence of the birds of prey nor the fixed regimen of the gallinaceous or aquatic birds. They live upon insects, fruits, and grain; but those with strong beaks live more exclusively upon grain, those with slender beaks upon insects. The proportional length of their wings and the extent of their flight are as variable as their habits. They have four toes, generally three in front and one behind; sometimes all four are in front; *but there are never two before and two behind*, as in the order of climbing birds (*Scansores*).

The order Passerinæ is divided into five families, as in the following Table:—

Passerine birds having	The external toe shorter than the middle one, and free for the greater part of its length . . . Upper mandible .	Notched on both sides near its point		**DENTIROSTRES**
		Without a notch	Short, wide, and flattened horizontally; mouth very open . .	**FISSIROSTRES.**
			Strong and conical	**CONIROSTRES.**
			Slender and elongated . . .	**TENUIROSTRES.**
	The external toe almost as long as the middle one to which it is united as far as to the last joint but one			**SYNDACTYLÆ.**

* Passer, *a sparrow*.

FAMILY OF DENTIROSTRES.*

This family includes those Passerinæ only that have the beak notched on both sides, near the point. They are all insectivorous, and most of them also eat berries and other tender fruits; such are

The **Shrikes** (*Lanius*). Though small in size, these birds are full of courage; they contend with birds of prey, and like them, live by rapine. They feed on insects and small birds, and always inhabit woods and bushes. They live in families, and fly irregularly and precipitately, uttering shrill cries. The Butcher Bird (*Lanius collurio*) destroys a great many small animals, birds, and young toads, as well as insects, such as grasshoppers, beetles, &c.; these it has the habit of impaling on the thorns of bushes, in order to devour them at leisure, or to find them again when wanted.

FIG. 345.—HEAD OF TYRANNUS.

The Fly-catchers (*Muscicapæ*),† the Thrushes, the Nightingale, the Wrens, the Wagtails, the Titlarks, and many others of similar habits belong to this family.

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* Dens, dentis, *a tooth*; rostrum, *a beak—tooth-beaks.*
† Musca, *a fly*; capio, *to take or catch.*

FIG. 346.—GREY SHRIKE.

FAMILY OF FISSIROSTRES.*

The Fissirostres are distinguished by their beak, which is short, wide, horizontal, flattened, slightly hooked, without any notch, and very deeply cleft, the opening of the mouth is thus very wide, and they easily capture the insects they pursue on the wing. These birds are exclusively insectivorous; they are also migratory, and are found in all parts of the world. This family is divided into two tribes—namely, the Diurnal Fissirostres, with a dense plumage, and a beak that opens to beneath the eyes;

* Fissus, *cloven;* rostrum, *a beak—cleft-beaks.*

and the Nocturnal Fissirostres, the plumage of which is soft and light, like that of the Owls, and their beak opens to a point beyond the eyes.

FIG. 347.—HEAD OF NYCTIBIUS.

The Diurnal Fissirostres constitute the family of

The **Swallows** (*Hirundo*), all or which are remarkable for the

FIG. 348.—SWALLOW.

length of their wings. They are divided into Swallows, properly so called, and Swifts; the latter are known by a remarkable conformation of their feet, the thumb is directed forward like the other toes, which are all separate, and each has but three joints, while in the Swallows the thumb points backwards, as in the other Passerinæ.

The Swallows, properly so called, have a triangular beak, the legs short, the wings very long, and the tail usually forked. They delight in places where flies and other insects are common; they construct their nests with great care, sometimes in the ground. Most of the Swallows leave us in September, and migrate in large flocks to warm countries, where they pass the winter; they return in the beginning of spring, and take possession of the nests they had left the preceding year. Their habits are mild, and they are remarkable for their sociability. They often join together in great numbers to drive off an enemy, the attack of which any one of them may fear. The Swallow announces, even to the Swifts and other small birds, the approach of a bird of prey. At the sight of an Owl or a Hawk, it utters a piercing cry; immediately all the birds of its species and the Swifts assemble round it, and often fly in phalanx against the enemy, which they harass until he is forced to retreat.

The **Swifts** (*Chœtura, Cypselus*) have a forked tail, and surpass even

FIG. 349.—SWIFT.

the Swallows in their powers of flight; in fact, they scarcely walk at all, and are seen continually in flocks, pursuing insects in the upper regions of the atmosphere with loud cries. They nestle in holes in walls and rocks, and climb along smooth surfaces with facility.

The tribe of **Nocturnal Fissirostres** comprehends

The **Goatsuckers** (*Caprimulgus*),* consisting of several genera, very much resembling each other in their plumage and habits. They only appear in the evening, and for this reason they might be called crepuscular birds. The silky nature of their feathers and their mixed and mottled plumage give them, as far as relates to their colour, a strong resemblance to Owls. Their eyes are large: their beak, furnished with strong moustaches, and more deeply cleft than in Swallows, is capable of receiving the largest insects, which it retains by means of a viscid saliva. The nostrils are in the form of small tubes, near its base. Their wings are long, their legs short

FIG. 350.—NIGHT JAR.

and feathered, and the thumb can be directed forwards. These birds live solitary, and only fly during the twilight or on fine nights; they pursue moths and other nocturnal insects, and lay a small number of eggs on the ground, without taking much care to construct a nest. When they fly, the rushing of the air into their wide mouths produces a peculiar humming noise. They have been accused of sucking goats, whence their name; but this is an unfounded calumny that, perhaps, had its origin from the circumstance of their frequenting fields where goats and sheep are herded, in pursuit of the insects that are attracted by their presence.

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* Capra, *a goat;* mulgeo, *to milk.*

Family of Conirostres.*

All the birds of this family have a strong beak, more or less conical in its shape, and without a notch. They live more exclusively upon grain, in proportion to the strength and thickness of their bills. The principal genera are the Starlings, the Larks, the Titmice, the Buntings, the Sparrows, the Crossbills, the Crows, and the Birds of Paradise.

The **Larks** (*Alauda*) have a straight, short beak; their head is small, and furnished with a little crest of feathers; the nail of the hinder toe is straight, and much larger than that of any of the other toes. The conformation of their claws does not allow these birds to alight on trees; but it is useful to them on the ground, where they generally dwell, feeding on grasses, tender plants, insects and larvæ. They also have the habit of dusting themselves by fluttering on the ground. The Lark is common throughout Europe. During

Fig. 351.—SKY-LARK.

the summer these birds prefer dry elevated situations, and delight in soaring to great heights in the air, singing in a strong melodious voice. In winter they assemble in large numbers on the level country in search of food. They are often kept in cages, and become reconciled to captivity. Their flesh is esteemed a delicacy.

* Conus, *a cone;* rostrum, *a beak*—with conical beaks.

The **Titmice**, or **Tits** (*Parus*), have a slender and very short beak. They are extremely lively little birds, and may be constantly seen darting from branch to branch in short flights, climbing and suspending themselves in all sorts of positions, plucking the seeds upon which they feed. They also eat many insects, and do not spare small birds when they find them enfeebled by sickness or entangled in

FIG. 352.—LONG-TAILED TIT AND NEST.

snares; they may be often seen to pierce their skulls, by repeated strokes of their beak, in order to devour the brains; they also pick the bones to a skeleton. In proportion to their size, which is very small, these are the boldest of all birds. They attack Owls fiercely. They make their nests in the hollows of old trees, and lay more eggs than any others of the family.

Dr. Macgillivray records the observations of a friend on a pair of blue Titmice while rearing their young. The parent birds began their labour of love at half-past three o'clock in the morning, and did not leave off till after eight o'clock in the evening, after being almost incessantly engaged for eighteen hours, during which time they returned to their nest 475 times, flying to and from a plantation more than 150 yards from their nest; sometimes they brought at each visit a single caterpillar, sometimes two or three small ones. The number of destructive insects thus killed, while birds are feeding their young, must be astonishing.

The **Finches** (*Fringilla*) are too well known to require description. They form an extensive genus, embracing the Weavers, the Linnets, the Goldfinches, the Chaffinches, the Canary, the Bullfinch, and other cage birds.

The **Crows** (*Corvus*) have a large beak, straight at the base, curved towards the point, and cutting at the edges; their nostrils are concealed by long hairs directed forwards; their toes are entirely divided, and their wings appear clipped at their extremities. They live in troops, and are cunning and distrustful; they readily become familiar, and some of them may be taught to speak with considerable facility. The senses of these birds are very acute, more particularly that of smell; they have the habit of stealing and concealing everything they find, even articles that are useless to them, such as spoons and pieces of money. They lay up provision for the future season, and feed on every kind of aliment, grains, fruits, insects, and worms, and living or dead flesh, so that they well deserve the

FIG. 353.—CARRION CROW.

name of **Omnivorous**. The **Raven**, the **Jackdaw**, the **Magpie**, and the **Jay**, all belong to the same family.

The **Birds** of **Paradise** (*Paradisæa*). These birds resemble Crows in everything but their plumage, which is perhaps the most sumptuous bestowed upon the feathered creation. They are all of them indigenous to New Guinea and the neighbouring islands. Their history was for a long while a tissue of fable and absurdity. The female it was asserted laid her eggs while flying, and had no legs;

when sleeping, they were said to suspend themselves by the long feathers of the tail; to feed exclusively upon dew, and never to touch the earth while alive. All these fictions have, however, found their proper level, and the history of these beautiful birds is now pretty well known. The most celebrated species is

The **Emerald Bird of Paradise** (*Paradisæa apoda*). Its head is small, but ornamented with feathers that rival in brilliancy those of the Peacock; the neck is of a delicate yellow, and the body of a

FIG. 354.—BIRDS OF PARADISE.

rich brown tint sprinkled with gold; while two long bearded filaments constitute its tail. The long, light, and graceful feathers of this bird form the most beautiful, and, alas! the most sought-for plumes for ladies' head-dresses; so that the race will probably soon become extinct.

The Birds of Paradise travel in troops of thirty or forty under the direction of a chief, which the Indians call the king. In May and June (probably the season of pairing) they are in a state of great excitement and incessant activity, and the males assemble together to exercise, dress, and display their magnificent plumage. For this purpose they prefer certain lofty, large-leaved trees, and on these, early in the morning, from ten to twenty full-plumaged birds assemble, as the natives express it, "to play and dance." They open their wings, stretch out their necks, shake their bodies, and

keep their long golden plumes opened and vibrating—constantly changing their positions, flying across and across each other from branch to branch, and appearing proud of their activity and beauty. The long, downy, golden feathers are displayed in the manner in which alone they can be seen to full advantage; instead of hanging down each side, as during repose and flight, they are erected vertically over the back, and there opened and spread out like a fan, completely overshadowing the whole body. The effect of this is inexpressibly beautiful. The large ungainly legs are no longer a deformity, as the bird crouches upon them: the dark-brown body and wings form but a central support to the splendour above, from which more brilliant colours might distract attention; while the pale-yellow head, swelling throat of rich metallic green, and bright golden eye, give vivacity and life to the whole figure. Above rise the intensely-shining orange-coloured plumes, richly marked with a stripe of deep red, and opening out into broad waving wreaths of aëry down, curving and closing upon each other so as to form a sort of halo, in the centre of which the bright-green head looks like a little emerald sun, with its rays formed by the filaments of the two plumes.

Family of Tenuirostres.*

The birds composing this family have a slender elongated beak, always without any notch; it is sometimes straight and sometimes bent like a bow. The principal genera are the Nuthatches, Creepers, Humming-birds, and Hoopoes.

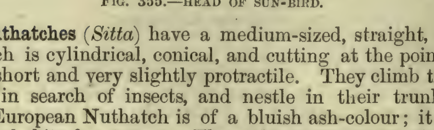

Fig. 355.—Head of sun-bird.

The **Nuthatches** (*Sitta*) have a medium-sized, straight, depressed beak, which is cylindrical, conical, and cutting at the point. Their tongue is short and very slightly protractile. They climb trees in all directions in search of insects, and nestle in their trunks. The Common European Nuthatch is of a bluish ash-colour; it is sedentary, and inhabits forest trees. The male assists the female in spring in the construction of her nest. They establish themselves in a hole in the tree, and if the hole is too large for them, they reduce its size by plastering it with mud, a habit that has acquired for them their name of "Mason Pie." They line the interior with a thin bed of moss, upon which the female lays from five to seven greyish eggs, speckled with red spots. The young escape from their shell about the month of May, and are very soon able to provide for themselves.

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* Tenuis, *slender;* rostrum, *a beak—slender-billed.*

These birds feed on grain and seeds, more especially flax-seed; they likewise eat beech-nuts and hazel-nuts, the latter of which they fix firmly in some crevice, and then pierce them by repeated blows of their sharp beak.

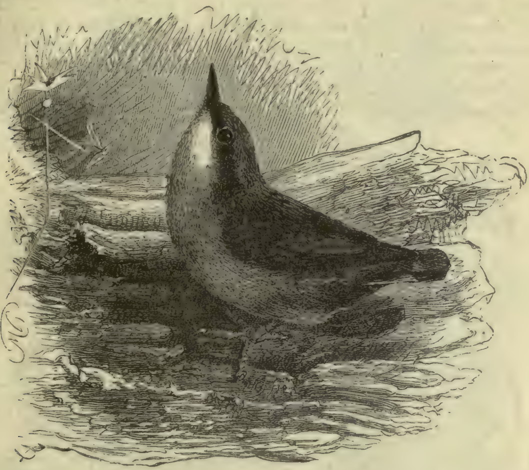

FIG. 356.—NUTHATCH.

The **Creepers** (*Certhia*) have their beak compressed and slender, more or less bent like a bow, and triangular; their tail is slanting,

FIG. 357.—TREE CREEPER.

and furnished with stiff sharp quills, serving to assist them in climbing trees; their tongue is sharp, and adapted for piercing insects, upon which they feed.

The **Humming-birds** (*Trochilus*) are celebrated for the metallic lustre of their plumage, as well as for their tiny dimensions. They inhabit America and the adjacent islands. Their beak is very long, sometimes straight and sometimes bent, tubular, and very slender. Their tongue is long, extensible, and divided into two filaments. Their wings are proportionately very long, and their plumage some times ornamented with feathers as brilliant as precious stones.

FIG. 358.—HUMMING-BIRDS.

They feed on the nectar of flowers, about which they may be seen buzzing and balancing themselves in the air. They sometimes eat small flies and diminutive insects, found in the flower-bells. They live in pairs, and defend their nest most courageously.

FIG. 359.—HOOPOE.

The **Hoopoes** (*Upupa*) have an ornament on the head formed of a double row of feathers that they can erect at will.

FAMILY OF SYNDACTYLÆ.*

The birds belonging to this family are recognisable by having the external toe almost as long as the middle one, to which it is joined by a membrane that reaches as far as the last joint but one. The principal genera are the Kingfishers, the Bee-eaters, and the Hornbills, all readily distinguishable by the structure of the beak.

The **Bee-eaters** (*Merops*) have the bill of moderate size, cutting, pointed, and slightly curved, without any notch at the end. The Common European Bee-eater (*Merops apiaster*): the only one found in Europe has a fawn-coloured back, a deep blue front, and a yellow throat, surmounted with black. It lives upon insects, particularly

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* *σύν*, syn, *together with ; δάκτυλος*, dactylos, *a finger or toe*—i.e. *having conjoined toes.*

wasps and bees, which it seizes while on the wing. It constructs its nest on the precipitous banks of streams and large rivers, digging to a considerable depth.

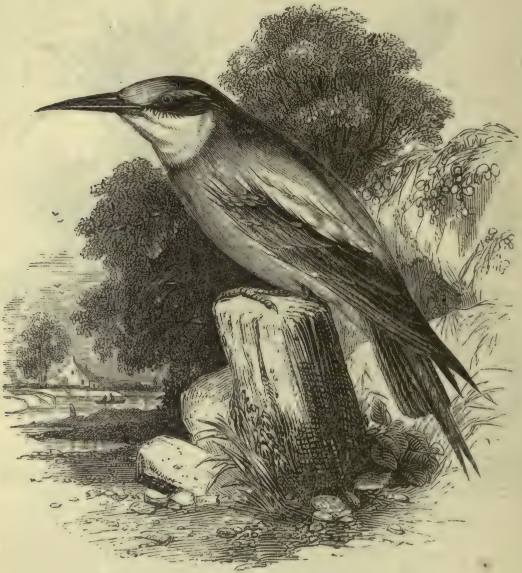

FIG. 360.—BEE-EATER.

The **Kingfishers** (*Alcedo*) have a quadrangular beak, which is long, straight, pointed, and trenchant; their legs are short and bare to above the knees. The only species found in Europe is the *Alcedo ispida*, a beautiful bird. His plumage is green and black above, with a stripe of red beneath, and a riband of the same colour on each side of the neck. His delight is to dwell amidst the most sequestered scenes on the borders of rivers and streams abounding in small fish and insects, upon which he feeds. On the broken or rocky bank of his aquatic retreat he may be frequently seen perched on some projecting bough, scrutinizing the waters for his expected prey; if unsuccessful, he comes along the stream just above the surface, and occasionally hovers for an instant with rapidly-moving wings over the spot where he perceives his gliding quarry; in the next instant, with a swift spiral sweep, he seizes a fish, which he swallows in an instant.

FIG. 361.—KINGFISHER.

The **Hornbills** (*Buceros*)* are large birds of India and Africa, remarkable for their enormous toothed beaks, surmounted by a crest or prominence almost as large as the beak itself. They live upon mice, reptiles, small birds, and dead animals.

ORDER OF SCANSORES† OR CLIMBERS.

In all birds belonging to this Order the outer toe can be directed backwards like the thumb, an arrangement that enables them more firmly to grasp the boughs of trees, and which some genera employ for clinging to and climbing their trunks. The climbers generally make their nests in the hollows of old trees. Their powers of flight are moderate. Some feed on insects, some on fruits, according to the structure of their beak. In this order are found the **Woodpeckers**,

* βοῦς, bous, *an ox*; κέρας, keras, *a horn*; because their beak somewhat resembles the horn of an ox.

† Scando, scansum, *to climb*.

the **Wrynecks**, the **Cuckoos**, the **Parrots**, and the **Toucans.**

FIG. 362.—FOOT OF PARROT AND OF WOODPECKER.

Tabular arrangement of Scansorial Birds.	Having the beak	Straight	And angular; tongue very extensible and armed with spines at the tip . . .	**WOODPECKERS.**
			And rounded; tongue very extensible, but without spines .	**WRYNECKS.**
		Arched	Moderate in size and slightly arched .	**CUCKOOS.**
			Large, rounded on all sides, and having the upper mandible strongly hooked .	**PARROTS.**
			Almost as long as the body	**TOUCANS.**

The **Woodpeckers** (*Picus*) are distinguished by their long, straight, strong beak, which is angular, adapted for piercing the bark of trees; their remarkable tongue can be extended to a great distance beyond the bill, and is armed near the end with horny barbs directed backwards. Their tail is composed of ten stiff and elastic quills that serve them as a support when they climb. They all have the habit of tapping and raising up the bark of trees, to seize the insects concealed beneath. Most Woodpeckers are marked with red either on the head or body. Their cry is sharp, and their flight heavy.

FIG. 363.—GREAT BLACK WOODPECKER.

The **Wrynecks** (*Yunx*) have the protractile tongue of the Woodpecker, but without its spines. Their straight and pointed beak is nearly round, without any well-marked angles, and is not sufficiently strong to penetrate or raise the bark of trees. Like the Woodpeckers, they live on insects, but climb much less. The Wryneck derives its name from a peculiar habit of bending the neck sideways, so that the head is turned towards the back with the eyes half closed.

FIG. 364.—WRYNECK.

The **Cuckoos** (*Cuculus*) have a moderate beak, well cleft and

FIG. 365.—CUCKOO.

slightly arched; the tail is long and composed of ten quills. They are birds of passage and live upon insects. The female Cuckoo makes no nest and takes no care of her young; she deposits her eggs in the nests of other birds. The strange nurses, to whom the Cuckoo confides her young, become not only good mothers to the progeny that does not belong to them, but neglect their own offspring; nay, improbable as it may appear, the young Cuckoos push the rival nestlings out of the nests, of which they take possession for three weeks after their birth, and for five weeks longer their adopted mothers supply them with food.

The **Toucans** (*Ramphastos*)* are at once distinguishable by their enormous beak, which is almost as large and as long as their body; internally it is light and cellular, and at its margin irregularly

FIG. 366.—KEEL-BEAKED TOUCAN.

toothed. Their tongue is long, narrow, and furnished on each side with barbs like a feather. These strangely-constructed birds inhabit the tropical parts of America; they live in flocks, and feed on fruits

* ῥάμφος, ramphos, *a beak.*

and insects. They seek the nests of other birds, and devour their eggs and recently-hatched young. When they obtain their prey, they toss it into the air, and, catching it as it falls, swallow it whole.

The **Parrots** (*Psittacus*) have a large, hard, and solid beak, with the upper mandible arched and strongly hooked. They climb trees by the aid both of their beak and feet; their tongue is fleshy and round, and their toes short and strong. They readily become familiar, and some species can be taught to imitate the human voice. The plumage of Parrots varies in colour; it is generally remarkable for

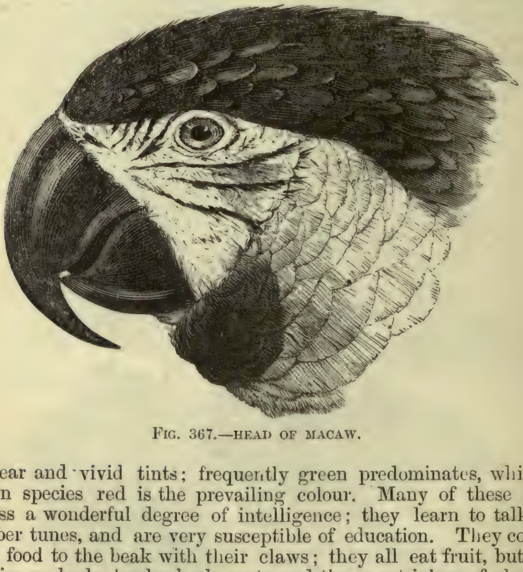

FIG. 367.—HEAD OF MACAW.

its clear and vivid tints; frequently green predominates, while in certain species red is the prevailing colour. Many of these birds possess a wonderful degree of intelligence; they learn to talk, remember tunes, and are very susceptible of education. They convey their food to the beak with their claws; they all eat fruit, but feed likewise on buds, tender bark, roots, and the sweet juices of plants.

To this family belong the *Macaws*, the *Paroquets*, the *True Parrots* and the *Cockatoos*.

ORDER OF GALLINACEOUS* BIRDS.

The Gallinaceous Birds are terrestrial. They have a short or moderately long beak, which is vaulted above. Their body is heavy, and their wings generally short. They all live upon grain, and are furnished with a very strong muscular gizzard; they

* Gallus, *a cock;* Gallina, *a hen.* Barn-door Fowls being taken as the type of the order.

delight in seeking their food upon the ground and in scratching in the dust. Most of our poultry belongs to this Order; their flesh supplies a light and wholesome meat, and their feathers are applied to various purposes, both ornamental and useful.

This Order is divided into two sections—

The **Gallinaceæ,** properly so called, having the front toes united at their base by a short membrane, and their tail composed of fourteen or a still greater number of quills; and

The **Pigeons,** having their toes entirely separate, and the tail formed of twelve quills.

Family of Gallinaceæ, properly so called.

The Gallinaceæ properly so called have a short convex beak, with the upper mandible arched or vaulted, and curved from its base to its point. Their three front toes are united by a short membrane; the posterior toe is affixed high up. The principal genera of the Gallinaceæ are the **Turkeys,** the **Peacocks,** the **Guinea-fowl,** the **Pheasants,** and the **Grouse.**

Tabular arrangement of Gallinaceous Birds, properly so called,	Having a tail	Which may be erected so as to form a circle; having the head	And the top of the neck covered with a red and warty skin			**TURKEYS.**
			Covered with feathers and ornamented with a crest or tuft			**PEACOCKS.**
		Which cannot be erected so as to form a circle, and is	Large, rounded, and composed of twelve quills			**CURASSOWS or HOCCOS.**
			Composed of feathers	Imbricated, *i.e.* overlapping one another like the tiles of a house.		**PHEASANTS.**
				Inclined or pendent	Head naked, and the cheeks furnished with fleshy wattles	**GUINEA FOWL.**
					Having a stripe of naked skin in place of eyebrows. .	**GROUSE**

The **Turkeys** (*Meleagris*) have the head and the upper part of the neck covered by a soft skin, which is destitute of feathers. Under the throat there is a fleshy appendage that hangs from the neck, and another of a conical form from the forehead; these in the male become turgid during excitement. A bunch of stiff hairs, likewise, is appended to the breast of the male. The tail coverts can be raised so as to form a circle, and the males have feeble spurs. Turkeys, of which only two species are known, are originally from America, whence the Jesuit missionaries introduced them into Europe. The first Turkeys appeared in France in 1570, and were served at the wedding of Charles IX. They have since been naturalized in all climates on account of the excellence of their flesh.

The **Peacocks** (*Pavo*) have the head covered with feathers and ornamented with a crest; the legs are armed behind with a conical spur; but the most remarkable characteristic of these birds is, that

FIG. 368.—PEACOCK.

in the male the upper tail coverts are longer than the quills, and may be elevated when he spreads his tail, the feathers of which are of un-

equal size, and terminated by numerous brilliant circles of metallic splendour. The female is destitute of this ornament, the richness and beauty of which are beyond description.

The **Guinea Fowls**, or **Pintadoes** (*Numida*), have the head naked and provided with fleshy wattles on the lower part of the cheeks; their skull is likewise generally surmounted by a callous crest. Their feet are without spurs, and their tail is short and pendent. The Guinea Fowls, as their name implies, are of African origin; they live in numerous troops under bushes and in copses, where they find berries and small snails, on which they feed.

The **Pheasants** (*Phasianus*) have the cheeks around the eyes covered by a red skin, or by very short feathers; their tail is long

FIG. 369.—HASTINGS'S TRAPOGAN, ARGUS PHEASANT, AND CROWNED PIGEON.

and narrow, with the feathers arranged in two planes that overlap each other, the middle ones being considerably the longest. They are all natives of Asia, and seem to increase in beauty as we go further east, until in China we find the beautiful Gold and Silver Pheasants and the superb Argus, represented in our figure, studded with dark ringed eye-spots on a cinnamon ground, and almost rival-

ling the Peacocks in the richness of its costume. The Pheasants of our preserves (*P. Colchicus*) are said to have been imported into Greece by the adventurous Argonauts from the banks of the river Phasis, whence the origin of their name.

The **Barn-door Fowl** (*Gallus*) is furnished with a fleshy crest or comb upon the crown of the head and wattles on the throat. The quills of the tail are fourteen in number, placed back to back on two planes, and the tail coverts, greatly lengthened, extend in the adult male with a graceful arch over the quills.

The **Curassows** (*Crax*), of which there are many species nearly as large as a Turkey, are almost invariably of a deep black colour, glossed with metallic reflections. Some of them are adorned with a

FIG. 370.—CRESTED CURASSOW.

crest composed of short curled feathers. They live in flocks in South America, where they perch and build their nests upon the loftiest trees.

The **Grouse** (*Tetrao*) are distinguishable by a naked and generally red stripe that occupies the place of the eyebrows. This family comprises the Heathcocks, the Partridges, the Ptarmigans, and the Quails.

The **Capercailzie, or Cock of the Wood** (*Tetrao urogallus*), is almost as large as a Turkey. Although formerly common in the northern parts of this country, this noble bird has been nearly exterminated: efforts have, however, been recently made to restore, if possible, the breed by importing a large number from Norway, where they are still numerous. Some species of grouse, which seem to belong to the northern regions of the globe, are defended amidst the snows, over which they wander, by having their feet feathered to the claws, and by their plumage becoming white in winter.

FIG. 371.—CAPERCAILZIE.

The second section of gallinaceous birds includes the extensive tribe of Pigeons, sometimes regarded by naturalists as forming an order by themselves.

FIG. 372.—WOOD PIGEON.

The **Pigeons** (*Columba*), like the preceding, have the beak vaulted, the nostrils pierced in a membranous space, and covered with a cartilaginous scale, that causes a considerable prominence at the base of the beak. These birds fly well, the males attach themselves strictly to a single female. with whom they live, roosting upon trees or in the clefts of rocks,—they lay few eggs, but at intervals frequently repeated. The male assists the female in the work of incubation. They feed their young brood with grain previously softened in their own craw.

Order of Running Birds.

Cursores.*

The principal characteristic of these birds consists in the undeveloped condition of their wings, which are quite disproportioned to the size of the body, and completely incapable of flight. In some cases, these rudimentary wings are but imperfectly furnished with feathers, in others they are fully plumed, but even then seem only to be used after the manner of sails, to catch the wind and thus assist in running. They run with extraordinary swiftness, and hence the name **Cursores,** or **Runners,** is applied to them with great propriety. The living species form two families, of one of which the Ostrich, and of the other, the Apteryx, is the type.

The **Ostriches** (*Struthionidæ*) are remarkable for the great size and strength of their legs; the shortness of their wings is such that they are quite unadapted for flight.

The **True Ostriches** (*Struthio*), however, still have their wings covered with loose and floating plumes of sufficient length to afford them considerable assistance in running. Two species only are known. The African Ostrich (*Struthio camelus*), and the American Ostrich (*Struthio Rhœa*).

The **African Ostrich** has only two toes upon each foot; and the outermost of the two, which is but half the length of the inner one, is without a claw. These birds are very numerous in the sandy deserts of Arabia and of the interior of Africa; they attain the height of seven or eight feet, live in large flocks, and lay eggs that weigh nearly three pounds apiece: in intertropical regions these eggs are simply buried in the sand, but beyond the tropics the female sits

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* Cursor, *a runner*, from curro, *to run.*

upon her eggs, and defends her progeny courageously. No animal can beat the Ostrich in running.

The **American** or **Rhœa Ostrich** is only half the size of the African bird, and has three toes, all furnished with claws. The plumage is of little value.

FIG. 373.—AFRICAN OSTRICH.

The **Cassowary** (*Casuarius*) has wings still shorter than those of the Ostrich, and quite useless even in running. Their feet have three toes, all provided with nails; their feathers almost resemble the hairs of a horse's mane. But two species are known, one having its head surmounted by a bony helmet, the other unprovided with such a covering. In running, they can outstrip the swiftest greyhound.

The **Bustards** (*Otis*). This fine bird is almost extirpated, though it is still seen in wide open plains. The last recorded to have been killed in England was shot near the Lizard, in Cornwall, in February, 1843. The male Bustard stands nearly four feet high.

FIG. 374.—GREAT BUSTARD.

The second division of Cursorial Birds form the family of Apteryx (*Apteryzidæ*), so called because they have the appearance of being entirely wingless. They resemble the Emeu in the general form of their body and in the nature of their plumage; but are at once distinguished from those ostrich-like birds by the shortness of their legs, and the presence of a hind toe, armed with a strong claw on each foot. A further distinction is afforded by the form of the bill, which is elongated, nearly cylindrical, and slightly curved; the nostrils are situated quite at the tip of the upper mandible, and the wings are so rudimentary as to be completely concealed beneath the feathers of the body.

Shaw's Apteryx (*Apteryx Australis*) is an inhabitant of New Zealand. It stands about two feet high, and its plumage is of a dark brown colour. It runs with great rapidity, and when pursued takes refuge in the holes of rocks or amongst the roots of trees.

FIG. 375 —APTERYX.

When seized it defends itself vigorously with its powerful feet. It is active during the night, and feeds principally upon earthworms, which it captures by driving its long bill into the soil. These birds live in pairs, and construct a rough nest in the retreat which they generally frequent. In this nest the female lays a single egg, about the size of that of a goose. Their flesh is much esteemed by the New Zealanders, who make cloaks of their skins and feathers.

ORDER OF WADING BIRDS

GRALLATORES.*

These birds derive their name from their habits and from the peculiarities of their structure. They are characterized by the height of their legs, which are naked, and thus adapted for wading to a certain depth into the water, where many species catch their prey. Those genera that are possessed of a

* Grallæ, *stilts*, so called from their stilt-like legs.

strong beak, live upon fishes and reptiles; those in which the bill is long and feeble, upon worms and insects: a very small number satisfy their appetite by devouring grain or herbs, and these only such as live at a distance from water. In a few instances the toes are partially webbed, and in some the hinder toe is entirely wanting; circumstances which have considerable influence in causing their habits to be more or less aquatic. Their wings are long, and they generally fly well. During flight their legs are stretched out behind, while in other birds they are generally folded beneath the body. They are separable into four tribes, namely, the **Pressirostres**, the **Cultrirostres**, the **Longirostres**, and the **Macrodactyles**.

The tribe **Pressirostres*** comprehends such genera as have their legs long and their hind-toe too short to touch the ground. Their beak is sufficiently strong to pierce the ground in search of worms, and consequently the smaller species may be seen running about in meadows and newly-ploughed fields. Others possessed of stronger bills, likewise eat grain and plants. In this tribe are classed

FIG. 376.—RINGED PLOVER.

* Pressus, *compressed*; rostrum, *the beak*.

The **Plovers** (*Charadrias*). These birds have no hinder toe, and a moderate beak, which is compressed and slightly enlarged at the tip. They live together in numerous flocks, frequent damp meadows, and strike the earth with their feet, in order to disturb the worms upon which they live.

We may also mention the **Sand-pipers** (*Tringa*) and the **Oyster-catchers** (*Hæmatopus*), the latter having a beak straight, pointed, compressed into a wedge shape, and sufficiently strong to enable them to open small shell-fish, upon which they feed. They likewise, however, dig in the earth in search of worms. Most of the little birds of this tribe make no regular nest, but deposit their eggs, four in number, in a cavity slightly scratched among sand and pebbles,

FIG. 377.—NEST OF THE DUNLIN.

which they so much resemble in size and colour that they are not easily discovered; or like the Sea-snipe, they construct on the ground, among long grass and heather, an apology for a nest composed of a little moss and some dried leaves and fibres. In this the female contrives to place her eggs so that they occupy the smallest possible space, by making them all meet at their smaller ends, which taper much more than the eggs of most other birds (Fig. 377).

The **Cultrirostres** * are known by their large, long, and strong beak, which is generally trenchant and sharp pointed; in

The **Cranes** (*Grus*), however, the bill is scarcely longer than the

FIG. 378.—CROWNED CRANE

head. The common Crane (*Grus cinerea*) is a very beautiful bird, standing upwards of four feet in height: it has been celebrated from the remotest antiquity on account of its periodical migration, which carries it every autumn from north to south, and every spring in the opposite direction, on these occasions Cranes fly in numerous flocks and observe the most perfect discipline. These birds will eat grain, but they prefer insects and worms, which they obtain abundantly in the marshy countries they frequent. The ancients frequently make allusion to the Cranes, because their high road during their migrations lies through Greece and Asia Minor.

The **Herons** (*Ardea*) are more carnivorous in their habits, and are provided with a long, sharp beak, cloven to beneath the eyes. They are likewise remarkable for having the inner edge of the middle claw of each foot horny and toothed like a comb. The Herons are solitary birds, they roost or perch themselves by the side of streams, where they destroy much fish.

The **Storks** (*Ciconia*) are furnished with a beak of still more formidable proportions, and their feet are slightly webbed at the base. They have the habit of striking their broad mandibles sharply together, thus producing a clapping sound, the only noise that they make. The White Stork (*Ciconia alba*), very common on the Continent, builds its nest upon steeples, towers, and other lofty

* Culter, *the coulter of a plough;* rostrum, *a beak.*

FIG. 379.—HERON.

objects; frequently upon a cart-wheel purposely placed as a scaffold for its accommodation. These birds are not only tolerated, but they are held in special regard, on account of the services that they render in destroying reptiles and all sorts of vermin, as well as offal, which they greedily devour.

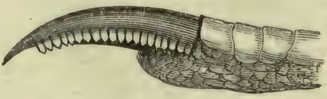

FIG. 380.—CLAW OF HERON.

The **Spoonbills** (*Platalea*) resemble the Storks in everything but the structure of their beak, which is very peculiar; it is long, broad, and flattened out near its extremity into a spatula-like plate, so feeble as no longer to be fit for anything but dabbling in the mud in search of little fishes or aquatic worms and insects.

The third tribe **Longirostres,*** composed of Wading Birds, comprehends numerous genera that habitually frequent the banks of rivers. All the genera resem-

* Longus, *long;* rostrum, *a beak.*

FIG. 381.—SNIPE.

ble each other very much in their form and general habits, and frequently even in their colours, so that it is difficult to draw any well-marked distinctions between them. They are, however, emphatically characterized by their beak, which is long, slender, and feeble, so that it is principally used for probing the soft earth in search of the grubs and worms upon which they feed. To this tribe belongs

The **Ibis** (*Ibis*); distinguished by the shape of its long and slender bill, which is thick and square at the base, but gradually tapering towards its extremity, and bent downwards like a bow; the head, and sometimes the neck, is partially denuded of feathers: the outer toes are webbed at their base, and the hinder toe sufficiently long to reach the ground. The most celebrated species is the sacred Ibis of Egypt (*Ibis religiosa*). By the ancient Egyptians this bird was educated in their temples, and embalmed after its death. It seems to have been an object of religious worship on account of its habit of devouring serpents, or, perhaps, because its appearance was generally simultaneous with the overflow of the Nile, to which that country owes so much of its fertility.

The **Scarlet Ibis**, met with in the tropical regions of America, is a beautiful bird; its body is of a brilliant scarlet, with the wing feathers of a deep black. It may be seen in flocks in marshy places near the mouths of rivers, and is easily tamed.

FIG. 382.—IBIS.

The **Curlews** (*Numenius*) are provided with a beak, arched like that of the Ibis, tapering, slender, and round throughout its entire

length; the end of the upper mandible projects beyond the lower, and the toes are webbed near their bases. The Common Curlew of our coast has been named from its peculiar cry; its flesh is sometimes eaten, but it makes a very indifferent apology for game.

The family of **Snipes** (*Scolopacidæ*) have the bill straight, and the nostrils prolonged by grooves until very near the tip, which is slightly enlarged, and projects a little beyond the lower mandible.

FIG. 384.—WOODCOCK.

The extremity of the bill in these birds is soft and very sensitive. Their feet have no traces of a web; all of them have their head more or less flattened, and their great eyes placed very far back, giving them the appearance of being very stupid, and indeed their habits quite agree in this respect with their physiognomy.

The **Woodcock** (*Scolopax rusticola*) and the **Common Snipe** (*S. Gallinago*) are well-known examples of this extensive family, as are the **Turnstones** (*Strepselas*).

Many of these birds migrate at certain seasons. The period of their migrations is fixed by nature for each species, and it is remarked that they follow the same route every year; hence, in certain districts the fowlers or birdcatchers count upon their arrival as upon rent that falls due on a certain day, and calculate in advance the period of their passage. Armed with their nets, and all the apparatus of the chase, they station themselves in the gorges and in the valleys through which the flocks are to pass, and await their coming just as they would the arrival of a railway train.

The family of **Long Toes** (*Macrodactyles*)* have their toes very much lengthened, so as to be adapted for walking over the floating vegetation of marshes, or even for swimming, should their possessors happen to fall from their unstable footing into the water; nevertheless, their feet are not webbed. Their beak is more or less compressed at the sides, and is never so slender or so long as in the preceding family. The body of these birds is also remarkably flattened, their wings are of moderate size or short, and their flight feeble; in all of them the hind toe is very long. To this family belong

The **Jacanas** (*Parra*), distinguishable from all other wading birds by having their four toes much elongated and separate quite to their roots; the nails upon all their toes are likewise of extraordinary length and very sharp, from which circumstance they have obtained the common name of "Surgeons;" a cognomen, however, which they rather seem to deserve on account of the structure of their wings, which are armed with sharp spines. All these birds are extremely noisy and quarrelsome; they abound among the marshes of tropical countries, upon the floating weeds of which they walk by means of their wide-spreading toes.

The **Rails** (*Rallus*) likewise belong to this group; some of them, as the Common Water Rail (*Rallus aquaticus*) frequent our brooks

FIG. 385.—LAND RAIL.

and large ponds, where they manage to swim very well, and also to

* *μακρός*, macros, *long*: *δάκτυλος*, dactylos, *a toe*.

run lightly over the leaves that float upon the surface; they feed upon little fresh-water shrimps; their flesh smells of the marsh.

The **Land Rail** (*Rallus Crex*), on the contrary, lives and hides itself in the fields, running along amongst the grass with considerable swiftness; his Latin name Crex is expressive of his cry. He is sometimes called on the continent the "*King of the Quails*," because he arrives and departs at the same time as those birds, and lives nearly in the same localities, so that the vulgar give him credit for guiding all their movements. The Land Rail lives upon grain, as well as upon insects and worms.

The **Coots** (*Fulica*), in the shape of their beak, resemble the Land Rail, from which they are distinguished by a broad horny prolon-

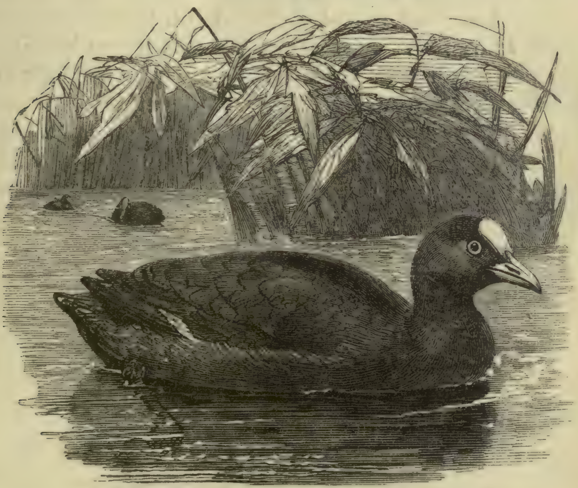

FIG. 356.—COMMON COOT.

gation from the beak, that covers their forehead, which is long and edged upon each side by a narrow border. Our common species, the "Water-hen," is very widely distributed.

Included in this extensive Order we find

The **Flamingoes** (*Phœnicopterus**), one of the most extraordinary and most isolated genera in the entire series of the feathered creation. Their legs are excessively elongated so as to exceed in their length those of many wading birds. Their three front toes are webbed as far as their extremities, while the hinder toe is extremely short; their neck is as long and as slender as their legs, and their small head supports a beak of very peculiar construction, being so bent that the upper mandible is nearest the ground when the animal

* *φοίνικεος*, phoinikeos, *purple*; *πτερόν*, pteron, *a wing.*

collects its food from the marshy soil. They feed upon shelled mollusks, insects, and eggs of fishes, which they procure by means of their long neck and their strangely-shaped beak. They construct their nest upon a raised platform that they build in the marshes, and sit astraddle upon it during incubation, their long legs preventing them from taking any other position. Flamingoes are common both in the old and new world, but they are seldom found further north than the 40th degree of latitude; sometimes, however, they are to be seen on the banks of the Rhine.

Palmipedes* or Swimming Birds.

The last and lowest Order of birds comprehends those whose feet are specially made for swimming; they are placed far back upon the body, the legs are short and compressed, and the toes are connected together by a web. Their plumage is thick and shining, impregnated with oil, and closely packed with soft *down*, so as to preserve them from all contact with the water in which they live. They are

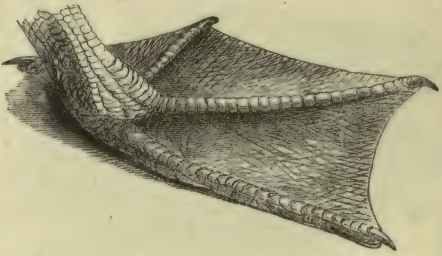

Fig. 387.—Foot of Pelican.

also the only birds the length of whose neck sometimes much surpasses that of their legs, thus enabling them, while swimming on the surface, to obtain their food at the bottom.

The birds belonging to this order may be divided into four sections, as in the following table:—

* Palma, *the palm;* pes, *the foot—palm-footed.*

Having excessively short wings, and the legs placed so far back that they are obliged, when on land, to preserve almost a vertical position. They fly little or not at all			**BRACHYPTERES.** **DIVERS.**
Having the wings of ordinary length, or even very long, and the feet so placed as to enable the bird to walk when in a horizontal position . . .	Beak horny	The thumb free or wanting, wings excessively long	**LONGIPENNES.**
		The thumb united to the other toes by a common membrane, wings long . . .	**TOTIPALMATÆ.**
	The beak covered by a soft skin and the edges furnished with transverse ridges or very fine tooth-like points		**LAMELLIROSTRES.**

The **Short-wings** (*Brachypteres* *), exhibit considerable relationship with the Water-hens. In these birds the legs are situated further back than in any others, so that they walk with difficulty, and are obliged to stand almost in an upright position. They swim badly on the surface of the water, and many of them cannot fly at all on account of the shortness of their wings; they may, therefore, be regarded as exclusively water-birds; their plumage is consequently exceedingly thick and smooth, so as to have almost a silvery appearance. They dive with great ease, using their wings almost in the same manner as fins. To this family belong

The **Divers** (*Colymbidæ*), distinguishable by their smooth, straight, compressed, and pointed beak. They are, however, divisible according to the structure of their feet into

The **Grebes** (*Podiceps* †), which, instead of truly webbed feet, only have their toes expanded by the addition of folds of skin at their sides and base. The semi-metallic brilliancy of their plumage often causes the skins of these birds to be used as a substitute for furs; they live upon the margins of lakes and ponds, and make their nests among the reeds; under some circumstances they are said to gather their young under their wings.

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* βραχύς, brachys, *short; πτέρον*, pteron, *a wing*.

† Podex, *the rump;* pes, *a foot*—so-called from the legs being placed so far back.

The **Divers,** properly so called (*Colymbus*),* possess the general form of Grebes, but have their feet completely webbed, that is to say, their toes are united quite to their extremities, where they terminate in strong pointed nails. These are all Northern birds, and only visit us in the winter season.

FIG. 388.—NORTHERN DIVER.

The **Great Northern Diver** (*Colymbus glacialis*) is frequently seen upon our northern coasts; they dive with the utmost facility, and live upon fishes and crabs that they catch under water.

The Penguins (*Alcidæ*) are known by the beak being much compressed and elevated vertically, presenting a sharp ridge on its upper margin, and generally grooved transversely. The feet are completely webbed, and have no posterior toe. This family is divided into the Puffins and the Penguins.

The **Puffins** (*Fratércula*), have the beak shorter than the head, and as wide at the base as it is long, a structure which gives these birds a very remarkable appearance; the root of the beak is bedded in a fold of skin, while the nostrils are only narrow slits placed near its margin. Their little wings can scarcely sustain them in the air for an instant. They live upon the sea, and make their nest among

* κολυμβητής, colymbetes, *a diver.*

the rocks. Puffins are found in great numbers on our northern shores.

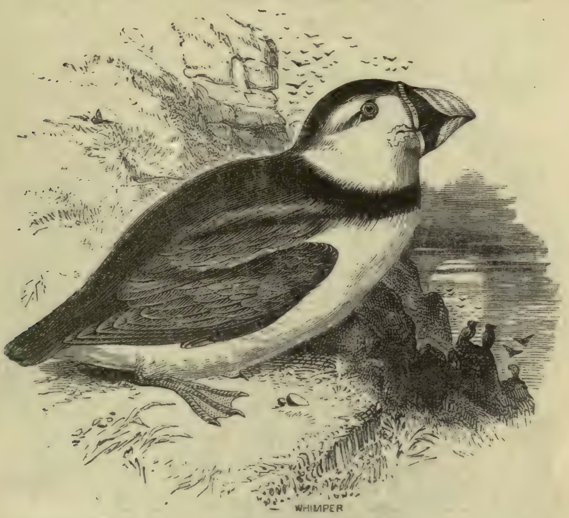

FIG. 389.—PUFFIN.

The **Penguins**, properly so called (*Alca*), have the bill elongated like the blade of a knife, and covered with feathers as far as the nostrils. Their wings are so decidedly too small to sustain their weight that they never fly at all.

The manner in which they feed their young is curious and rather amusing. The old bird gets on a little eminence and makes a great noise, between quacking and braying, holding its head up in the air, as if it was haranguing the penguinary, while the young one stands close to it, but a little lower. The old bird having continued its clatter for about a minute, puts its head down, and opens its mouth widely, into which the young one thrusts its head and appears to suck from the throat of its mother for a minute or two, after which the clatter is repeated, and the young one fed again : this continues for about ten minutes.—DARWIN.

The **Common Penguins** (*Alca torda* and *pica*) are about the size of ducks, while the **Great Penguin** (*Alca impennis*) equals that of a goose.* The latter lays but a single egg, which is spotted with purple.

* Perhaps we ought rather to say *equalled* that of a goose, for although a few years ago these birds were sufficiently common, such has been the relentless warfare carried on against them that the species is believed by ornithologists to be now totally extinct.

The **King Penguins** (*Aptenodytes* *) are even less capable of flight than the preceding. Their little wings are covered with apologies for feathers, that rather resemble scales, and their feet, which are

FIG. 390.—PENGUINS.

placed further back than those of any other bird, support their weight upon the whole length of the tarsus, which is flattened out like the sole of the foot of a quadruped. Their feet, moreover, have the three front toes completely webbed, and the hinder toe directed inwards. These birds are only met with in the Antarctic seas, and seldom come on shore except to build their nests.

The family of **Long-wings** (*Longipennes* †) comprehends numerous birds always met with on the wide ocean, and distributed everywhere, so that they are encountered by navigators in all parts of the world. They are to be recognized by having their hind-toe free or else wanting; by their very long wings, and by their beak, which is without

* ἀπτήν, apten, *unwinged:* δύτης, dytes, *a diver—wingless divers.*
† Longus, *long;* penna, *a wing.*

denticulations, hooked at the end in some species, and simply pointed in others.

The **Petrels** (*Procellaria*) have their beaks hooked at the extremity which seems to be made of a piece distinct from the rest. The nostrils are united to form a tube, laid along the back of the upper mandible. Their feet present, instead of the hinder toe,

FIG. 391.—STORMY PETREL.

a simple claw inserted into the heel. Of all the swimming birds these are most constantly met with at great distances from land, so that when a tempest approaches, they are often obliged to take refuge upon shoals, or on board of vessels. They make their nests in the holes of rocks, and are specially abundant in the Antarctic regions.

The **Albatrosses** (*Diomedea*) are the largest of all water-birds. The beak of the Albatross is large, strong, and cutting, seemingly formed of several distinct pieces, and terminated by a hook that has the appearance of being fixed on to the end. The nostrils resemble two short tubes laid along the sides of the beak. Their feet have no hinder toe, and are even destitute of the little claw that we have noticed in the Petrels. They inhabit all the seas of the southern hemisphere, and live on fishes, mollusks, and other marine animals. The species most commonly known (*Diomedea exulans*) is often called by sailors the Cape Sheep, partly on account of its size, and partly from its colour; it also receives the name of *Man-of-war bird*. It is a great enemy to flying fishes. These magnificent birds come on shore to rear their young; they construct a nest of raised earth on which they lay their eggs, which are numerous, and good to eat. The voice of the Albatross is said to be as loud as that of an Ass.

The **Sea Gulls** (*Larus*) have the beak compressed, elongated, and pointed, the upper jaw being hooked near its extremity. Their nostrils, situated towards the middle of the upper mandible, are narrow slits. These are all cowardly but voracious birds, generally

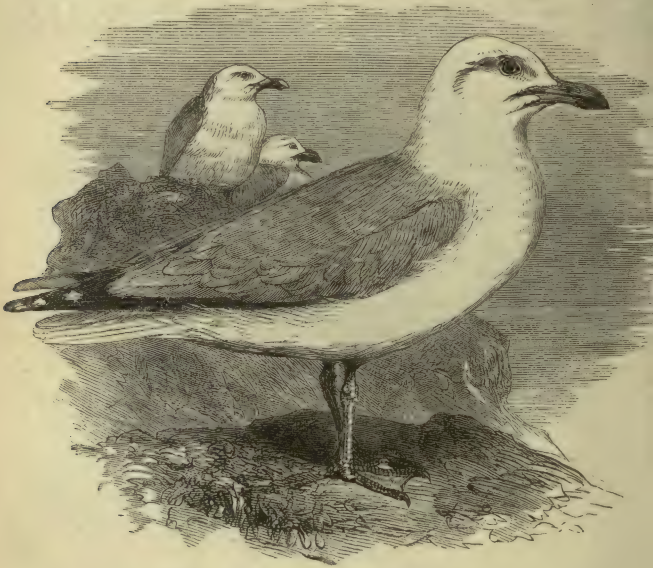

FIG. 392.—HERRING GULL.

seen flying about near the shore, feeding upon fish or any dead carcases they may happen to meet with. They make their nests in the sand or in the clefts of rocks, and lay but few eggs. Sometimes they are found at a considerable distance inland, which is regarded as a sign of bad weather.

The **Terns** or **Sea Swallows** (*Sterna*). These birds derive their name from their extremely long and pointed wings, their forked tail and short feet, giving them an appearance and mode of flight very much resembling that of the Swallows. Their beak is pointed, compressed, and straight, and the membranes that web their toes deeply notched, so that they swim but little, but they fly over the sea with astonishing rapidity, uttering loud cries and cleverly picking up from the surface of the water the mollusks and little fishes upon which they feed; they may sometimes be seen skimming over lakes and rivers in the interior of the country.

FIG. 393.—COMMON TERN.

The **Skimmers** (*Rhynchops*) resemble the Sea Swallows in the smallness of their feet, their long wings, and their forked tail, but are distinguished from all other birds by the extraordinary structure of their beak—the upper mandible is much shorter than the lower, and both so flattened sideways that they resemble horny blades, the edges of which meet without fitting into each other. These birds, therefore, only obtain their food by skimming the surface of the water as they fly, by means of their projecting lower jaw.

The next family, **Totipalmatæ**,* is recognizable from the circumstance that all the four toes, including the hind one, are webbed together by membrane, thus constituting them the most perfectly constructed for swimming of the whole race, and yet notwithstanding this, they are the only Palmipedes that perch on trees; their legs are short, and they are all excellent swimmers. To this family belong

The **Pelicans** (*Pelecanidæ*), comprehending those genera which have a space at the base of their beak denuded of feathers. Their nostrils are slits, the openings of which are scarcely perceptible; the

* Totus, *entire;* palma, *the sole of the foot;*—so called because their toes are united together by one continuous web.

skin of their throat is more or less extensible, and their tongue is very small.

The **Pelicans**, properly so called (*Pelicanus*), are provided with a beak remarkable for its great length; it is flattened horizontally, very broad, and terminated by a large hook. The lower mandible is very remarkable: it consists of two long flexible branches that sustain a wide muscular bag. The Common Pelican (*Pelicanus Onocrotalus*) is about the size of a swan; its plumage white, with a roseate tint, and the hook at the end of its beak blood-red; it is able to carry provisions and water in the bag beneath its throat.

The **Cormorants** (*Phalacrocorax* *) have the beak elongated and compressed, and the end of the upper mandible hooked; the claw of

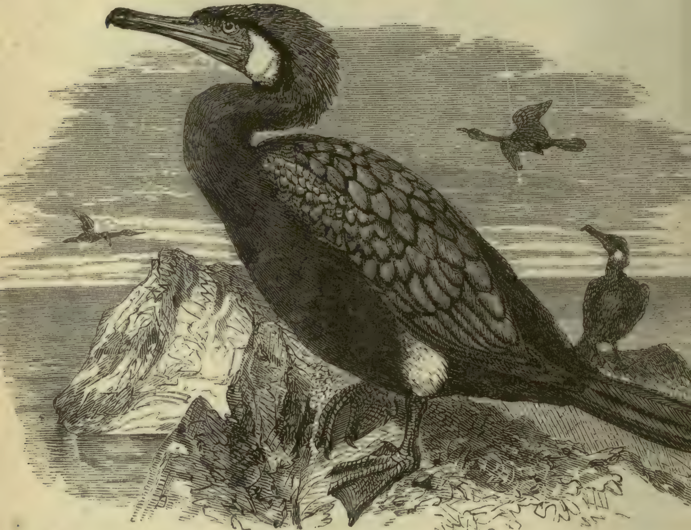

FIG. 394.—CORMORANT.

the middle toe is toothed like a saw. These birds are proverbially voracious and destructive to fish. They make their nests in the clefts of rocks, and amongst trees, where they lay three or four eggs.

The **Frigate Birds** (*Pelicanus aquilas*) differ from the Cormorants in having a forked tail, and both mandibles hooked at the end. Their flight is so powerful that they are everywhere to be seen in tropical seas at immense distances from land, sweeping down upon flying fishes, or pursuing other birds, which they compel to disgorge their prey. The spread of their wings is sometimes ten feet from tip to tip.

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* φάλακρός, phalacros, *bald-headed;* κόραξ, corax, *a crow—bald-headed crow.*

The **Gannets** (*Sula*) and the **Tropic Birds** (*Phaëton*) are of similar structure and habits, but of smaller dimensions.

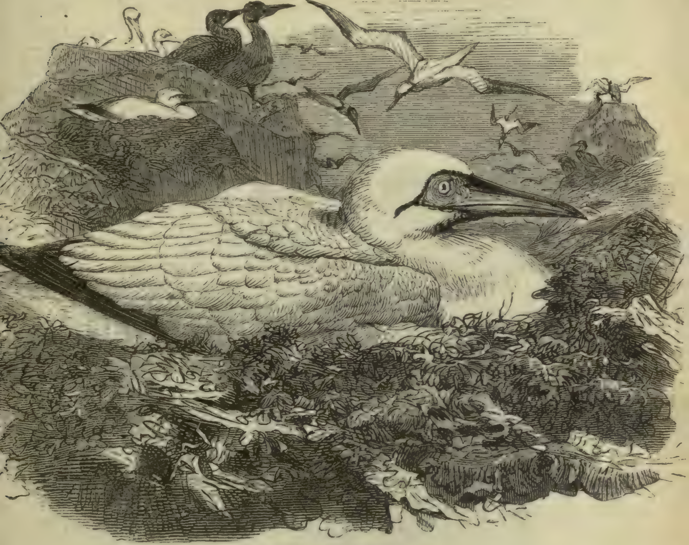

FIG. 395.—THE GANNET.

In the family of **Lamellirostres*** the beak is thick and covered with a soft skin instead of true horn; its edges are furnished with ridges resembling little

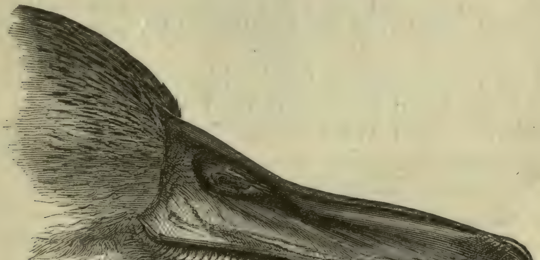

FIG. 396.—BEAK OF DUCK.

* Lamella, *a flat plate* ; rostrum, *a beak*.

teeth, the tongue is broad and fleshy, and toothed at the margin. The wings are of moderate length. These birds are inhabitants of fresh water rather than of the sea.

The **Ducks** (*Anatidæ*). This extensive genus comprises all birds having their beak large, broad, and furnished at the edges with

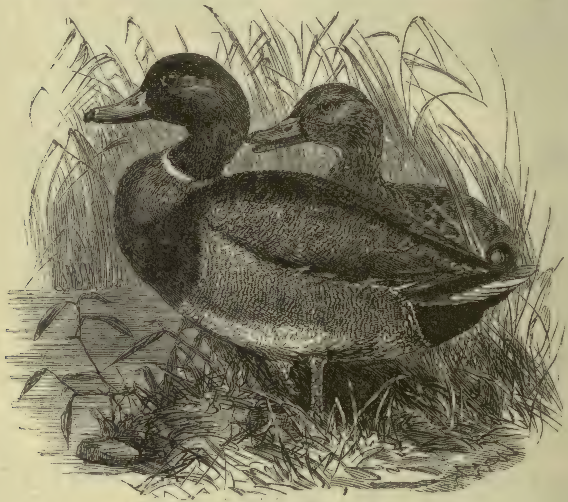

FIG. 397.—THE WILD DUCK.

the prominent ridges above mentioned, which allow the water to escape when the bird has seized its food. The **Swans** (*Cygnus*), the **Geese** (*Anser*), and the true Ducks (*Anas*), are all included under the same general appellation.

Few circumstances in the history of these aquatic races are more wonderful than their periodical migrations. The Wild Geese, guided by an unseen power, seek in spring the wild regions of the north, in companies disposed in regular phalanx. During the whole journey the most perfect order prevails. The conducting of the troop is confided to a chief, placed at the head of two files, more or less diverging, but always meeting at a point. The chief, placed at the apex of this moving angle, opposes the first resistance to the air; he clears the way, and the

whole band follows him, observing the strictest discipline. As the duties of the leader are very arduous, and as he cannot support them during the whole voyage, he may be perceived, when overcome with fatigue, to yield his post to his next neighbour and fall again into the ranks at the extremity of one or other of the files. Some species fly alone, and singly undertake their long and trackless voyage, solitary but not unguided by the Hand that points their way.

CHAPTER XXVII.

Mammalia.*

The essential character whereby this class of animals is distinguished from all others, is that the creatures composing it bring forth living young, which they suckle, and thus nourish for a time with their *milk*. In birds, the duties and the pleasures inseparable from the necessity of incubating their eggs, and of providing nutriment for their callow brood, are indeed manifested to an extent unparalleled in the preceding orders of Vertebrata; but it is to the Mammalia alone, the most sagacious and intelligent of all the inhabitants of this world, that the Creator has permitted the full endearment of paternal and maternal love, has thrown the offspring absolutely helpless, to be dependent on a mother's care and solicitude, and thus confers upon the parent emotions that a mother only knows, the dearest, purest, bestowed upon animal creation.

Besides the leading feature of their economy, namely, the production of milk for the nourishment of their young, the Mammalia are distinguished by the following peculiarities:—They all breathe air by means of lungs, suspended freely in a cavity, which is separated from the abdomen by

* From "mamma," *the breast*;—because they suckle their young.

a muscular partition, called the *diaphragm*, the movements of which, by enlarging the chest, are the principal cause of the inspiration of air. The heart is double—that is, consists of two ventricles for the propulsion of blood through the arteries, and two auricles for its reception from the veins. The mouth is closed by fleshy lips, and the skin, with but few exceptions, is covered with hair. The teeth in Mammalia are organs of great importance to the Zoologist. They are generally placed in single series, and vary much in their form, according to the nature of the food, as well as according to their position in the mouth. In man, there are in each half of each jaw two front teeth, having the name of *incisors* or cutting teeth; one more pointed, called the *canine* or dog-tooth, or sometimes the eye-tooth; two somewhat flattened at the top, with single fangs, called *false molars*, and three, situated behind all the rest, called *true molars* or grinders. For simplicity, naturalists have invented the following tabular method of expressing the number and arrangement of the teeth, which is called the dental formula:—

$$\mathrm{I}\,\frac{2-2}{2-2}\quad \mathrm{C}\,\frac{1-1}{1-1}\quad \mathrm{F\,M}\,\frac{2-2}{2-2}\quad \mathrm{M}\,\frac{3-3}{3-3}=32,$$

meaning—*incisors*, two on each side in the upper and two on each side in the lower jaw—*canines*, one on each side in the upper and one on each side in the lower jaw—*false molars*, two on each side in both upper and lower jaws—*molars*, three on each side in both jaws—making in all thirty-two teeth.

In those races which feed exclusively on flesh, the molar teeth partake of a cutting character, while in those that subsist on grain and herbage, the molar or grinding structure prevails. Sometimes the incisors are curiously developed; in the Squirrels, Rats, and other similar animals, they project forwards, and are continually growing; in the Elephant they stand out in the form of huge curved

tusks, and in the Narwhal one is commonly suppressed, while the other grows into a long, spirally twisted, straight tusk, that projects like a horn in front of its head. The Whale has no teeth; but a series of horny plates, parallel to each other, depends from the upper jaw, and constitutes the valuable substance called whalebone. In the Ant-eaters, and some others of the Edentata, there are no teeth at all, while the Armadillo has ninety-six, and some of the Dolphins have a hundred and fifty.

All the parts of animal structure are in beautiful harmony with each other, and with the habits and instincts of the species. The short and powerful jaw in the Cats (*Felidæ*), the lacerating teeth, the muscular fore-limbs, their freedom of motion, the sharp, curved talons, the flexibility of the spine, and the straight and simple digestive canal, equally indicate activity and testify to the possession of sanguinary and carnivorous propensities. In the Camels, the prominent lips, the structure of the teeth, the broad spongy soles of the feet, the callous pads on the limbs, the complex digestive apparatus, and the water-cells, all point out a creature fitted for feeding on coarse and thorny herbage, and for traversing sandy deserts. Neither of these animals could exchange any portion of its structure with the other, without serious derangement of the whole. This correspondence of part with part, and the adaptation of every organ to the mode of life prescribed is so exactly maintained, that a skilful comparative anatomist can, from a single tooth or bone, build up in imagination the whole structure of an animal which he never saw, indicate its form, and pronounce with considerable confidence upon its food, its habits, and its manner of life.

The classification of the Mammalia is based upon the structure of their teeth and feet. These are the organs that most affect the conditions of existence under which each is found.

There is, however, one group, almost limited in

geographical extent to Australia and its islands, so peculiarly organised, that they may be considered as forming a connecting link between the true Mammals and the Oviparous Vertebrata, and to these remarkable quadrupeds we must next beg the reader's attention.

Sub-Class.—Ovo-vivipara.*

Order I.—Monotremata.†

The broad characters whereby a bird is distinguishable from a Mammiferous animal, as we have endeavoured to show, are plain and simple enough. The bird lays eggs and incubates them. The Mammal produces its young alive, and suckles them, yet strange to say, there are certain creatures so exactly intermediate in their organization between these two great classes, that even the anatomist has hesitated as to which of them they were strictly referable, although close research has at length decided their place to be among the Mammalia.

The **Duck-billed Platypus** ‡ (*Ornithorynchus* § *paradoxus*‖) is a quadruped, about two feet in length, with a rounded, flattened body, covered with short, soft fur, of a deep-brown hue; it has a broad, flat tail, very short legs, and the toes are united by a web, which in the forefeet spreads out considerably beyond the tips of the claws. This formation enables it to swim with ease and grace; but as it also burrows in the earth, the free part of the web folds back when the animal is thus engaged, and leaves the claws unencumbered. The muzzle very much resembles the broad flat bill of some of the ducks; it is covered with a blackish skin, which overlaps at the edges, and folds back at the base into a broad margin. The place of molar teeth is supplied by eight broad, horny excrescences (two on each side of each mandible), of an irregular form, which probably serve as

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* Ovum, *an egg;* viviparus, *giving birth to living offspring*—so called because it is problematical whether they produce eggs or living young.

† μόνος, monos, *single;* τρῆμα, trema, *an orifice*—*i.e.*, having a single excretory and generative outlet.

‡ πλατύς, platus, *broad;* πόυς, pous, *a foot.*

§ ὄρνις, ὄρνιθος, ornis, ornithos, *a bird;* ῥύγχος, rynchos, *a beak.*

‖ Paradoxical.

grinders, but have no roots. The eyes are small but brilliant, and the orifice of the ear is readily detected by its opening and closing in a living animal, though scarcely perceptible after death. This

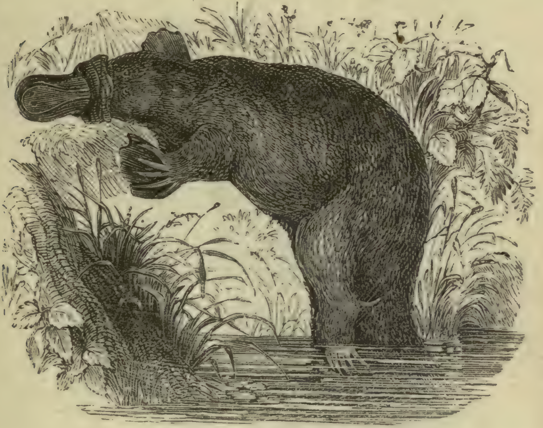

FIG. 398.—THE DUCK BILL.

creature is sometimes called the Water-mole. It delights to haunt the broad and tranquil ponds that are formed by the expansion of a stream, in which it swims and dives with great facility. Its burrow is formed in the bank, and runs to a great distance underground, sometimes extending even fifty feet. A nest of grass and

FIG. 399.—BURROW OF ORNITHORYNCHUS.

weeds is formed at the extremity, where the parent rears it young. The Ornythorynchus inhabits Australia.

The **Porcupine Ant-eater** (*Echidna aculeata*) is another Australian animal, the muzzle of which forms a beak, but less developed than in the Duck-bill. It is clothed with bristly black hair, among

which are many sharp spines. The tongue is long, capable of being thrust out to a great length, and covered with a glutinous secretion, by means of which it captures the Ants, that constitute its usual food.

FIG. 400.—THE PORCUPINE ANT-EATER.

ORDER II.—MARSUPIALIA.*

POUCHED QUADRUPEDS.

These animals are remarkable for the premature production of their young, which are born in so early a stage of their growth, that they are incapable of motion, and scarcely show the germs of limbs, or other external organs. These little ones remain attached to the teats of the mother, from whose milk they derive their food, and are carried about in a pouch formed by the skin of the abdomen, until they are able to provide for themselves. In some species, however, this pouch is deficient. The Marsupial quadrupeds have only been found in America, on the Australian continent, and in some of the adjacent islands. Australia, indeed, with a few doubtful exceptions, produces no indigenous mammiferous animals, but such as belong to this Order.

* Marsupium, *a pouch.*

The **Kangaroos** (*Macropus*)* are herbivorous, and remarkable for the smallness of their fore-feet, and the length of their hind-legs and tail, upon which they sit upright, as on a tripod, and by their assistance can make prodigious bounds, sometimes clearing a space of

FIG. 401.—COMMON KANGAROO.

twenty feet at a single leap. The middle toe of the hind foot is very large, and constitutes a formidable weapon. The Kangaroos inhabit Australia. One species (*M. Major*) stands upwards of six feet in length. The young are born in an extremely immature condition, and are received at birth into a pouch or fold of the skin of the abdomen of the mother. Here their naked and feeble bodies are protected from exposure to the air, and from all injury, until they are advanced in growth and strength. Within this abdominal pocket are situated the teats, to one of which the infant animal at a very early period attaches itself, and from it derives the nutriment, that gradually enables it to maintain an independent life. The Kangaroo thus carries about its young for a period of eight months; a little Kangaroo may then sometimes be seen putting its head out of the pouch, and nibbling the high-grass. At length it ventures forth and tries its strength alone; but on the least alarm, it springs again into its wonted hiding-place.

* *μακρός*, makros, *long ; πόυς*, pous, *the foot.*

The **Opossums** (*Didelphis**) have in all fifty teeth; thei tongue is rough and bristly, their tail prehensile, anc partly naked. The thumb of the hinder foot is long, anc considerably separated from the other toes. Their mouth which opens far back, and their large, naked ears, giv them a peculiar physiognomy. They are fetid anc nocturnal animals, very slow in their movements; they lodge in trees, and there pursue birds and insects, but they do not reject fruits. About thirty species have beer described.

The **Virginian Opossum** (*Didelphis Virginianus*) was the earlies known of the Marsupialia, and is one of the largest of the family

FIG. 402.—VIRGINIAN OPOSSUM.

It is about the size of a cat, covered with grey fur, thick and soft but of no value; lives on trees throughout the whole United States and is proverbial for its singular habit of counterfeiting death wher alarmed. Another species, found in South America, called th Mouse Opossum (*D. Murina*) (Fig. 403), has the Marsupial poucl imperfectly developed, to compensate for which the parent carrie her young upon her back, where they better maintain their position amidst the climbing and leaping movements of the mother, by twining their long, slender, and prehensile tails around hers.

The **Dasyuri** (*Dasyurus* †) have the tail covered with long hairs and not prehensile. They inhabit New Holland, and live on insects

* δίσ, dis, *double*; δελφύς, delphys, *a womb*.
† δασύς, dasys, *hairy*; ὀύρα, oura, *a tail*.

and dead flesh. Sometimes they get into houses, where their voracity makes them very unwelcome guests. They do not climb trees.

FIG. 403.—MOUSE OPOSSUM AND YOUNG.

The **Phalangers** (*Phalangistæ*) are climbers, and are furnished with a large opposable thumb. In their general form, they somewhat resemble squirrels; some of them have the skin of their flanks extended between the fore and hind legs, so as to form a sort of parachute, by the aid of which they take surprising leaps from one tree to another; these are called **Flying Phalangers**.

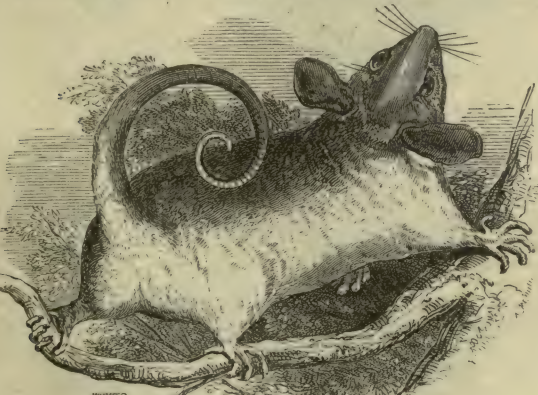

FIG. 404.—DORMOUSE PHALANGER.

The **Bandicoots** (*Peramelidæ*) remind us of the Shrews and other small insect-eating quadrupeds. They are said to live on insects, for

which diet their teeth seem suited; but some of the species are also reputed to feed on roots and bulbs.

Gunn's Bandicoot (*Perameles Gunnii*), a pretty creature, about as large as a Rabbit, marked across the loins with alternate black and

FIG. 405.—GUNN'S BANDICOOT.

white bands, is accused of inflicting great injury by destroying bulbs in gardens. These creatures are said also to devour corn in granaries, as rats and mice do in Europe.

The **Myrmecobius** is about the size of a Squirrel, nearly black be-

FIG. 406.—MYRMECOBIUS.

hind and bright brown in front, the whole body elegantly crossed by cream-coloured bands. It has a greater number of teeth than any other **Mammal**, except some of the Dolphins and Armadillos. They are thus arranged :—

$$I \frac{8}{6}; \quad C \frac{1-1}{1-1}; \quad F M \frac{4-4}{5-5}; \quad M \frac{4-4}{4-4} = 52$$

The **Wombat** (*Phascolomys* Wombat*) might almost be mistaken for a large Guinea-pig, but its shape is more clumsy and massive; it is found scattered over the whole southern part of New Holland and Van Dieman's Land. Its teeth resemble those of a gnawing quad-

FIG. 407.—WOMBAT.

ruped, such as the rat; its head is large, with the upper part flattened; the eyes are very small; the ears short and pointed, and the nostrils wide apart. The limbs are short; the feet broad and naked beneath. The claws are large and solid; those of the fore feet but slightly curved, and formed for digging. It lives entirely upon roots and vegetables, and its flesh is described as being excellent. It is of considerable size, attaining the length of three feet; it is therefore a valuable animal, and might be worth naturalizing in this country. This could probably be effected without any difficulty, specimens brought to Europe having lived for several years in a state of domestication.

The carnivorous **Marsupialia** are very few in num-

* φάσκωλος, phascolos, *a pouch*; μῦς, mus, *a mouse*.

ber; some of them, however, are formidable from their strength and ferocity.

The **Zebra Wolf**, or **Native Tiger** of the Australian colonists (*Thylacinus * cynocephalus*†), equals a large dog in size and strength, specimens having been found four feet in length, besides the tail, which is two more. It is nocturnal, like most beasts of prey, feeds on

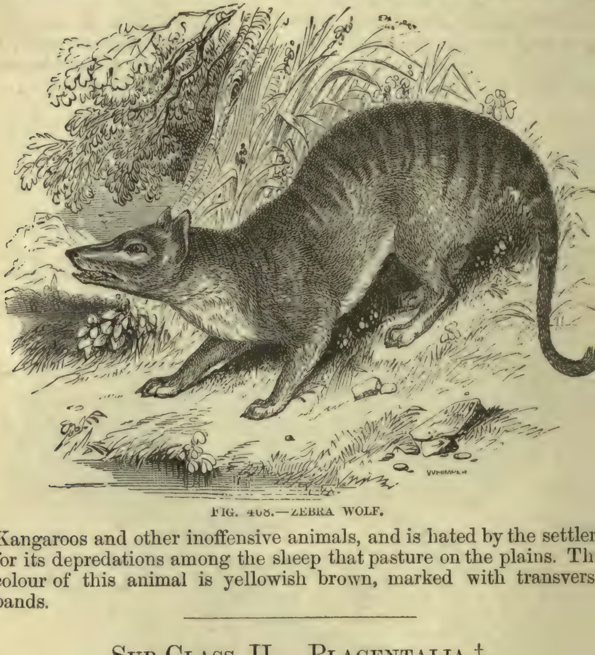

FIG. 408.—ZEBRA WOLF.

Kangaroos and other inoffensive animals, and is hated by the settlers for its depredations among the sheep that pasture on the plains. The colour of this animal is yellowish brown, marked with transverse bands.

SUB-CLASS II. PLACENTALIA.‡

PLACENTAL QUADRUPEDS.§

In the Placental Mammalia the young are born completely furnished with all their limbs, and for some time are nourished by milk derived from the maternal breast. They are classified as in the Table in the opposite page:—

* θύλακος, thylacos, *a pouch;* κύων, kyon, *a dog.*

† κύων, κυνός, kyon, kynos, *a dog;* κεφαλή, cephale, *a head.*

‡ Animals whose progeny are nourished by the intervention of a placenta, during the later stages of gestation.

§ Quatuor, *four;* pes, *a foot;*—a term generally applied to the mammalia.

PLACENTAL MAMMALIA. **LIMBS**	Two Pairs	Having fingers with nails **UNGUICULATA.**	With hands	On the anterior limbs only	**BIMANES**	**MAN.**
				On all the four limbs	**QUADRUMANA**	Monkeys, &c.
			Without hands. Set of teeth.	Complete	**CARNIVORA**	Bear, Cat, Seal, Bat, &c.
				Incomplete — Canines wanting	**RODENTIA**	Squirrel, Rat, &c.
				Incomplete — Incisors wanting	**EDENTATA**	Ant-eater, Sloth, &c.
		Having Hoofs **UNGULATA.** Stomach	Ordinary, not ruminant		**PACHYDERMATA**	Hog, Elephant, Horse, &c.
			Divided into four compartments, and formed for chewing the cud		**RUMINANTIA**	Ox, Sheep, Deer, &c.
	One pair only—formed for swimming				**CETACEA**	Dolphin, Whale, &c.

Order I.—Whales.

Cetacea.*

The Mammalia are all hot-blooded and air-breathing animals; nevertheless, even from this highly-organized and highly-gifted Class, numerous races have been selected, whose element is the ocean, whose home is in the deep. The inhabitants of the earth have their bodies supported upon four legs, so that they are necessarily restricted in their growth, and their bulk is apportioned to the strength of the limbs that bear their weight; but, in the water, being buoyed up on every side by the denser medium, the size of aquatic animals becomes of little consequence; thus the Whales attain prodigious dimensions, and, from the inexhaustible supply of food with which they are surrounded, find abundant materials for their sustenance.

The Cetacea are mammalia altogether deprived of hinder limbs. The trunk of their body is prolonged without any line of demarcation into a thick tail, terminated by a broad fin, very much resembling in its general shape that of a fish, but entirely composed of an expansion of the skin supported by a tough cartilaginous substance, and, instead of being placed vertically, to strike the water from side to side, it is horizontal, so that by means of its upward and downward movements, these animals easily come to the surface, or plunge perpendicularly into the depths below; their head is joined to the body without the intervention of any apparent neck, and their arms, the representatives of the fore-limbs of quadrupeds, are so flattened and concealed by the skin, that they might easily be mistaken for pectoral fins. When denuded of their flesh, however, they present, under a modified shape, bones and fingers corresponding with those met with in the Lion or the Bat. Thus, con-

* κῆτος, cetos, *a whale.*

structed entirely for swimming, the Cetacea are strictly confined to the watery element; neverthe-

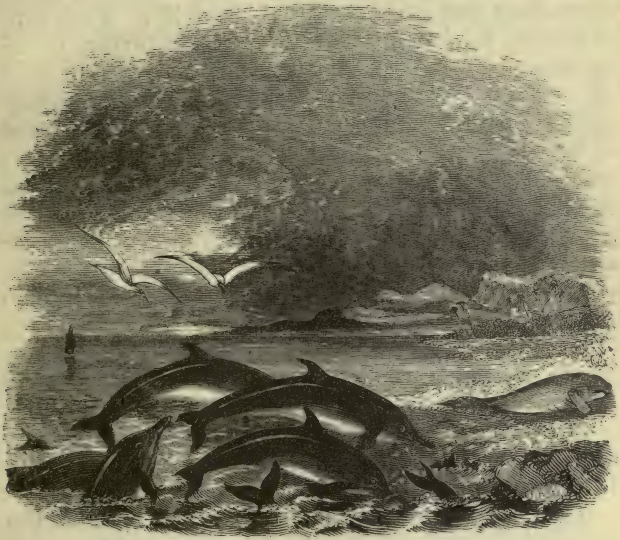

FIG. 409.—TROOP OF DOLPHINS, MANATEE IN THE DISTANCE.

less, they breathe air by means of lungs, and are thus perpetually obliged to come to the surface for the purpose of respiration. Their blood is hot; they bring forth living young, which they feed with their own milk, precisely in the same way as the terrestrial quadrupeds, and thus in all the details of their

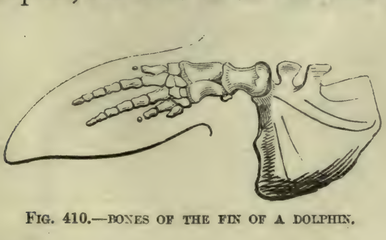

FIG. 410.—BONES OF THE FIN OF A DOLPHIN.

structure they differ widely from the cold-blooded, gill-breathing and oviparous fishes. Diving, as the Whales

not unfrequently do, to considerable depths, their bodies are subjected on such occasions to enormous pressure, to sustain which their body is enveloped in a covering that possesses great elasticity. Their skin is greatly thickened and made up of a texture of interwoven fibres, enclosing an immense quantity of oil or *blubber*, thus forming an integument admirably adapted to resist compression. This thick blanket of fat, moreover, retains the vital warmth, and thus enables the Cetaceans to inhabit even the coldest regions of the ocean. Being lighter than water, it also greatly contributes to the buoyancy of these unwieldy animals. A dead whale floats; but the carcase, when stripped of the blubber, sinks immediately.

The Cetaceans are divisible into two sections. Those having a head of ordinary proportions when compared with the size of their body, and those in which the head is of enormous dimensions. The first of these will include the **Dolphins** and the **Narwhals**; the second, **Whales**, properly so called.

The **Dolphins** (*Delphinus*) have teeth both in the

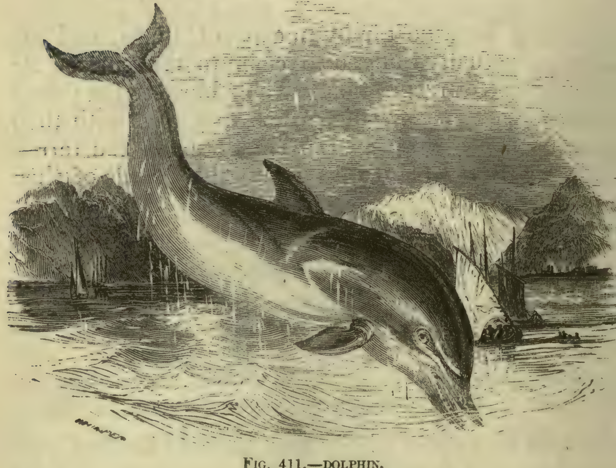

Fig. 411.—Dolphin.

upper and lower jaw, of the simplest structure and conical in shape. These animals are the most carnivorous, and, in proportion to their size, the most voracious of the Class.

The **Dolphins**, properly so called (*Delphinus*), have the forehead arched and the snout prolonged into a sort of beak.

The **Common Dolphin** (*Delphinus delphis*) is provided with from forty-two to forty-seven slender-curved and sharp-pointed teeth in each jaw; it is black above, white beneath, and from eight to ten feet in length. It is found abundantly around the British shores and all over the Atlantic and Mediterranean. Its elegant and graceful form, the extraordinary fleetness with which it darts through the water, and its agile gambols, have been celebrated in all ages.

The **Porpoises** (*Phocœna*) have no prolonged snout; their muzzle is short and uniformly convex.

The **Common Porpoise** (*Delphinus Phocœna*) is furnished with compressed, cutting teeth of a rounded form, about five and twenty in number on each side of both jaws. It is the smallest of the Cetacea, seldom exceeding four or five feet in length; it is very common in all our seas, where it is met with in large shoals.

The **Grampus** (*Delphinus Orca*) has thick conical teeth, about eleven in number on each side, a little crooked, the posterior ones flattened transversely. The body is black above, white below, with

FIG. 412.—SPEARING THE NARWHAL.

a white mark over the eye in the shape of a crescent. The dorsal fin is high and pointed. This is the largest of the Dolphins, being frequently from twenty to twenty-five feet long. Grampuses are said to attack the whale in troops, harass it until it opens its mouth, and then devour its tongue.

The **Narwhals** (*Monodon*) have no teeth in the mouth, but are furnished with a straight and pointed, tusk projecting from the upper jaw, and directed straight forward. The form of the head and body much resembles that of the Porpoises. Only one species is well known, namely,

The **Sea Unicorn** (*Monodon* monoceros*†). The tusk of this animal is sometimes ten feet long, spirally twisted, and was formerly thought to be the horn of the fabulous Unicorn. The Narwhal possesses, however, the germs of *two* tusks, one on each side; but it rarely happens that both grow equally. Usually that on the left side only is developed, and the other remains concealed in its socket. In general, this animal is not more than twice or three times the length of its tusk; its skin is marbled with brown and white; its blow-hole is at the top of its head; and, instead of a dorsal fin, it has a ridge running along the whole length of its back.

The other Cetacea have the head so large that it constitutes one-third or even one half of their length. The skull proper and the brain have nothing to do with this extreme disproportion, which is altogether

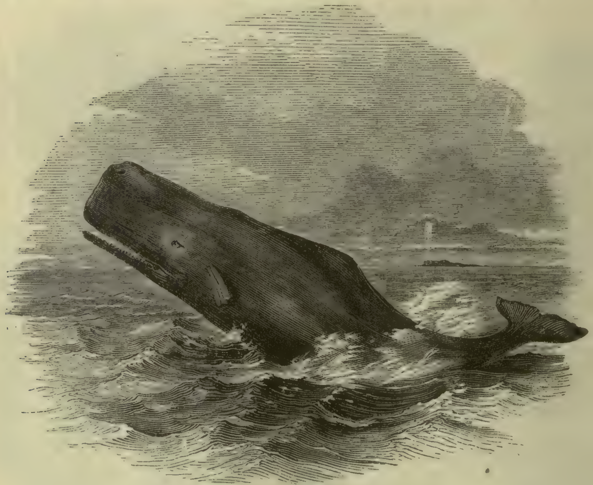

FIG. 413.—SPERM WHALE.

* *μόνος*, monos, *single*; *ὀδους*, *ὀδοντός*, odous, odontos, *a tooth*.
† *μόνος*, monos, *single*; *κερας*, ceras, *a horn*.

owing to the enormous size of the bones of the face. To this section belong

The **Cachalots** (*Physeter* *), generally called *Spermaceti Whales.* These animals have a very voluminous head, enormously expanded, especially in front. They have no whalebone nor any teeth in the upper jaw. Their lower jaw is narrow, and armed on each side with a row of conical or cylindrical teeth, which are received into corresponding cavities of the upper jaw when the mouth is closed. The upper part of their prodigious head is occupied by large excavations, or rather caverns, covered and separated by cartilaginous vaults, and filled with an oil that crystallizes as it cools into the substance well known in commerce by the name of *Spermaceti.* The cavities in which the spermaceti is lodged have nothing to do with the real skull, which is rather small, placed beneath them, and contains the brain in the usual manner. From the head of a single Cachalot are obtained from eighteen to twenty barrels of fluid Spermaceti. The usual length of this gigantic Cetacean is upwards of seventy feet, and its circumference at the largest part fifty-two feet.

The **Whalebone Whales** (*Balæna* †) are provided with heads of enormous magnitude in proportion to the size of their bodies, but not much expanded in front, and they have no true teeth. Their upper jaw has both its sides furnished with thickly set plates composed

FIG. 414.—WHALE FISHERY.

of a peculiar horny substance called Whalebone. These plates are thin and fringed at their margin, forming a kind of sieve, that serves to retain the small animals on which these gigantic creatures live.

* φυσητήρ, physeter, *a blower, or bellows.*
† Balæna, *a whale.*

The lower jaw, totally destitute of teeth, lodges a fleshy tongue of stupendous bulk, which, when the mouth is closed, compresses all the interior of the upper jaw and the plates of whalebone suspended from its roof. This structure of the mouth does not allow the Whales to live upon animals so large as their size would lead us to suppose. They subsist principally on small fish, but still more on worms, molluscs, and zoophytes, which become entangled in the

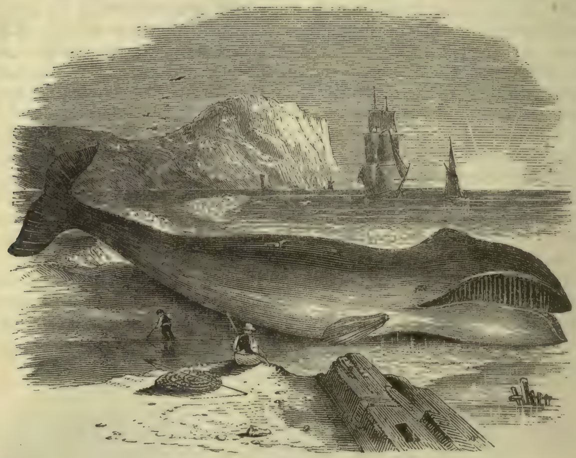

FIG. 415.—WHALEBONE WHALE.

fringes of their whalebone. The lower jaw is very deep, shaped somewhat like a vast spoon. When the Whale feeds it swims rapidly just under or at the surface, with its mouth wide open. The water, with all its contents, rushes into the immense cavity and filters out at the sides between the plates of the whalebone, which are so close, and so finely fringed, that every particle of solid matter is retained.

HERBIVOROUS CETACEA.

The Herbivorous Cetacea are provided with teeth having flat crowns, a character that indicates their mode of subsistence; accordingly, they emerge from the water to seek their pasture on the shore. They have two mammæ on the breast, and hairs like mustachios; two circumstances which, when they raise the body out of the water, give them some resemblance to men and women, and have probably given rise to the ancient fables about Tritons and

Sirens, and more modern tales of mermaids and similar monsters. Their nostrils open at the extremity of their muzzle.

The **Sea-cows** (*Manatus* *) have a long Whale-like body, terminated by an oblong, oval fin. Vestiges of claws may be discovered on the edges of their fin-like paws, indicating the tips of so many fingers, so that they can use their limbs with tolerable dexterity

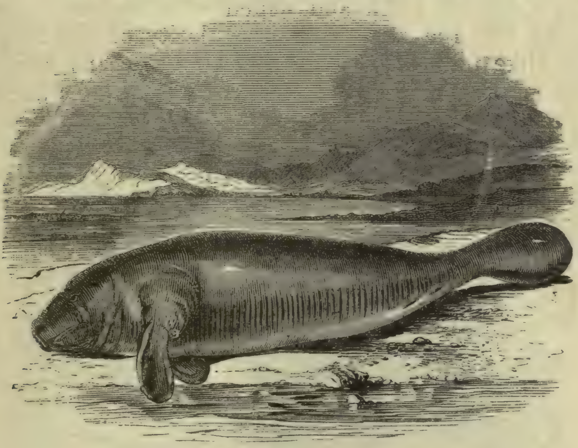

FIG. 416.—MANATEE.

in creeping upon the ground, and in carrying their little ones; these fins have been compared to hands, and hence is derived the name by which they are distinguished. They inhabit the warm regions of the Atlantic Ocean, near the mouths of rivers, which they sometimes ascend to a considerable distance. They live in flocks, often land, and are readily approached. They display the greatest attachment to their companions. The Manati are sometimes fifteen or even twenty feet in length; their flesh is eaten and esteemed a luxury.

The **Dugongs** (*Halicore* †) differ from the Manati by having their tail-fin shaped like a crescent, and pointed tusks that protrude from the upper jaw. They inhabit the shores of the Indian Ocean.

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* From manus, *a hand—furnished with hands.*
† ἅλς, hals, *the sea ;* κόρη, core, *a maiden.*

Order II.—Thick-skinned Quadrupeds.

Pachydermata.*

The relationship between the Whales and the Elephant is not very remote; the bulky head, the giant size, the thick and naked skin, the prolonged tusks, and the straggling irregularity of the teeth, are alike indicative of the aquatic Cetaceans and of the marsh-loving Pachyderms, that next offer themselves to our notice.

Fig. 417.—Wart-hog, Indian Rhinoceros, and River-horse.

These animals are remarkable for the thickness of their skin, and for having their toes enclosed in hoofs. They have a single stomach, and do not

* πaχύs, pachys, *thick*; δέρμα, derma, *the skin—thick-skinned.*

chew the cud. This order includes the largest terrestrial mammalia at present in existence. Except the horse, they are all clumsy in their shape, and have a heavy, indolent gait. They generally live together in herds, and frequent marshy situations, where they find vegetation and roots suited to their wants, and where they can wallow in the mud. Although they resemble each other in the general features of their economy, they are distinguishable by important particulars, which has rendered it necessary to divide them into the following groups:—

The **Proboscidian Pachyderms** are furnished with a proboscis; they have five toes on all the feet, but so enclosed in a sort of hoof of callous skin, that their nails only are visible. This family includes but one living genus, namely,

The **Elephants** (*Elephas*), animals of gigantic size, but mild and docile in their disposition. The proboscis of the Elephant is a

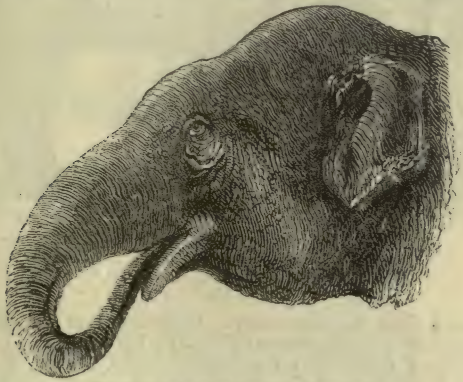

FIG. 418.—HEAD OF INDIAN ELEPHANT.

prolongation of its nostrils; it consists of a double tube surrounded with muscles variously interlaced, so that it is moveable in every direction, and terminates in a curious appendage resembling a finger. This trunk enables the Elephant to seize hold of everything he wishes to convey into his mouth, also to pump up water, and then to pour it into his throat, thus compensating for the shortness of the neck. By means of this wonderful instrument, Elephants can uproot trees, untie knots, open a lock, or even write with a pen. These animals possess a sharp sight; their hearing is quick, their sense of smell delicate. They are very intelligent, and

remember kindness as well as harshness. Elephants usually live together in herds, consisting of from forty to a hundred individuals. The oldest marches at the head of the troop, and the next in age watches the rear. They are easily tamed when taken young, and are employed as beasts of burden. They carry about two thousand pounds weight, and will travel without being very much fatigued, thirty or forty miles a day. These animals swim well: they live to the age of nearly two hundred years. Conscious of their own massive strength, they feared no enemies, till the aggressions of

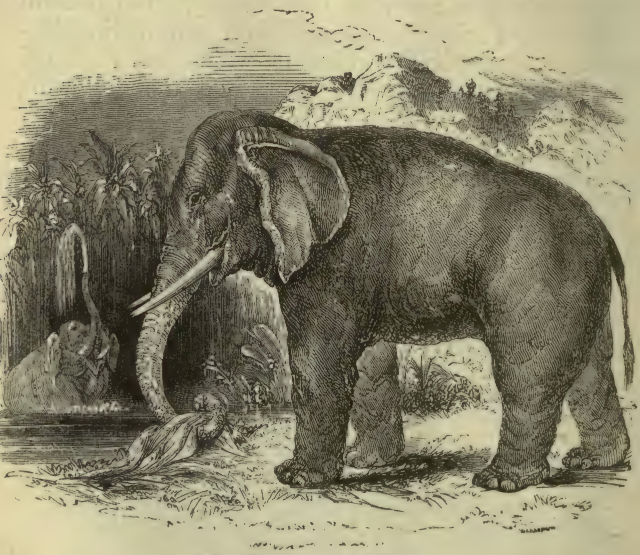

FIG. 419.—AFRICAN ELEPHANTS.

man taught them his superiority. Inoffensive and peaceful, they rarely use their gigantic powers of injury: but when irritated, they often exhibit a furious and revengeful ferocity. Heavy and massive in their structure, their pillar-like limbs seem ill calculated for speed, yet their "pace," when they have fairly commenced it, from the length of their stride, and the great propelling weight of their bodies, is for a time very rapid, and bears before it all ordinary obstacles, clearing a way through the thickest and most matted underwood.

Two species of Elephants are known in existing nature.

The **Indian Elephant** (*Elephas Indicus*) has an oblong head, a concave forehead, ears of middling size,

and four nails on the hind feet. Its tusks are often very short.

The **African Elephant** (*Elephas Africanus*) has a round head, a convex forehead, large flattened ears, and but three nails on the hind feet. It is more fierce than that of India; its tusks are much longer, and the female has them as long as the male. This species is not tamed.

The **Ordinary Pachyderms** are distinguished by having no prehensile trunk, and feet provided with three or four distinct toes. They are divided into several genera, as in the following Table:—

CLASSIFICATION OF ORDINARY PACHYDERMS.

Number of their toes .	Equal, and the foot having the appearance of being forked .	Four equal toes .	**HIPPOPOTAMUS.**
	Having on all the feet . .	Two large middle toes armed with strong hoofs, while the lateral toes are too short to rest on the ground . .	**HOG.**
	Unequal, and the foot not forked . .	Three toes on all the feet . . .	**RHINOCEROS.**
		Four toes before and three behind . . .	**TAPIR.**

The **River Horse** (*Hippopotamus* *) is found in most of the rivers of Africa, but in greatest numbers south of the equator. These are unwieldy looking animals, having their legs so short that the belly almost touches the ground. The feet are curiously constructed, so as to facilitate walking among the mud and reeds of the river bottoms, and enable them to swim with ease. The hoof is divided into four short, apparently clumsy, and unconnected toes, and they are able, through this spread of foot, to walk rapidly through the marsh. These animals consort together in flocks of from three to thirty. They choose shallow parts of the river, where the depth of the water allows them to keep their footing, and yet have their whole body submerged. Here they remain all day, swimming off into the deeps, and diving for their grassy food. They prefer parts of the river

* *ἵππος*, hippos, *a horse; ποταμός*, potamos, *a river.*

where the current is not very swift, and are therefore to be found in all the lakes of the interior.

The **Hogs** (*Sus*) have on all their feet two middle toes, which are

FIG. 420.—WILD BOAR.

of large size, and armed with strong hoofs, and two exterior toes, which are much shorter, and scarcely touch the ground in walking. Their canine teeth bend upwards, so as to form projecting tusks, and their snout is flattened, and adapted for rooting in the earth.

The **Rhinoceros** (*Rhinoceros**). These are large animals, with each

FIG. 421.—SKULL OF RHINOCEROS.

foot divided into three toes. The bones of the nose are very thick, and

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* *ῥίν, ῥινός*, rhin, rhinos, *a nose; κέρας*, keras, *a horn.*

united into a sort of vault, upon which is supported a solid horn, composed of agglutinated hairs. They frequent marshy places, and live on herbs and the branches of trees.

The **Tapirs** (*Tapir*) have their nose prolonged into a short pro-

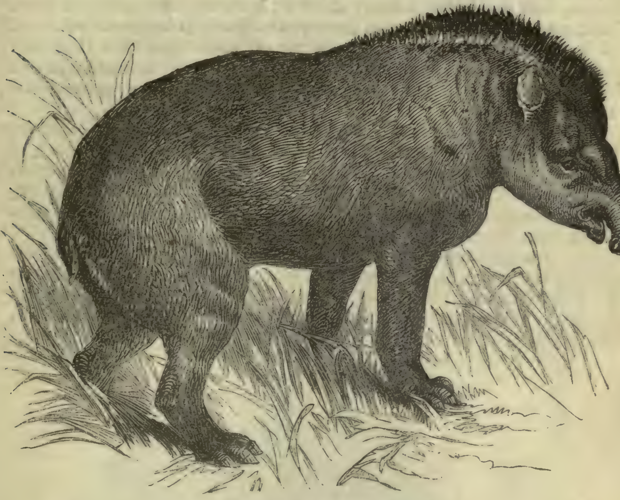

FIG. 422.—AMERICAN TAPIR.

boscis, which, although very moveable, is not prehensile, like that of the Elephant. There are several species known.

The third family of Pachydermata, or hoofed non-ruminating animals, comprehends

The **Solipedes**, having only one apparent toe on each foot, which is enclosed in a single hoof. They have, however, under the skin, the rudiments of lateral toes. Only one genus is known, namely,

The **Horses** (*Equus*), distinguished by having six incisors in each jaw; small canines likewise exist in the males, which are wanting in the females. Between the canines and the first cheek-tooth there is a space which corresponds with the angle of the lips, where the bit is placed, an arrangement by which alone man has been able to subjugate this vigorous quadruped.

The **Horse** (*Equus Caballus*), the noble companion of man in the

battle and the chase, in the labours of agriculture and of commerce, is of unknown origin. It would seem, he exists in a wild state, only in those places where horses, formerly domesticated, have been left in freedom, as in Tartary and America. In such places they live in troops, conducted and defended by an old male. The importation of horses into the latter country dates only about three hundred years back, and, nevertheless, wild horses exist there in immense numbers. It is asserted that troops consisting of more than ten thousand individuals are occasionally met with. The Horse is distinguished by the uniformity of his colour, and by his tail being ornamented with hair, quite from its origin.

As intrepid as his master, the horse sees danger only to face it; but docile as he is courageous, he responds to the slightest touch of the rein that guides him. The horse gives himself entirely up to the service of mankind, understands what is required from him, and, refusing nothing, labours with all his strength, and even dies rather than disobey.

The **Ass** (*Asinus*) is distinguished from the horse by his small size, by his long ears, by the black cross over his shoulders, and by the tuft of hair at the end of his tail. Though not so powerful as the horse, he is more patient and quiet, and scarcely less valuable to the peasant.

FIG. 423.—WILD ASS.

The Ass has been generally classed as a variety of the Horse. Dr. Gray, however, who has been followed by Professor Bell, separates the Ass, under the generic name of *Asinus*, leaving the Horse alone to fill the genus *Equus*.

The Ass, therefore, is not a Horse with a naked tail; he is no

mongrel, but like all other animals, has his family, his rank, and his species. Although his nobility is not quite so illustrious, it is quite as pure and quite as ancient, as that of the horse. Why, therefore, is it, that the Ass, so patient, so sober, so useful, is treated with so little consideration? Is it because he serves mankind too well and too cheaply? No one ever seems to think, as, stick in hand, he drives the overladen slave along the dusty road, that were there no horses in the world, the Ass would be the most useful, and doubtless the best cared-for, animal in creation. As it is, he is only the second, instead of being the first; but being second, he is looked upon with contempt. It is by comparison only that he is so degraded; he is regarded, not in accordance with what he is, but with what he is not: he has all the attributes belonging to his own nature, perfect in their kind; but we expect in him the form and qualities of the horse, which he does not and ought not to possess. His natural disposition is as humble, as patient, as quiet as that of the horse is proud, ardent, and impetuous. He suffers with constancy, and with courage, the blows which he does not deserve; he is content with the coarsest herbage; in everything the willing slave of man: his only deficiency is, that he is not a horse.

The **Zebra** (*Asinus Zebra*), very like the Ass in form and proportions, is at once the most elegant, and the most intractable of animals. His skin has the softness of satin, and is adorned with beautiful

FIG 424.—ZEBRA.

ribbon-like stripes. In the female, these stripes are alternately black and white; in the male, brown and yellow. The limbs are remarkably slender. These animals are found in the southern parts of Africa, and numerous herds are often seen grazing on the extensive plains of the Cape of Good Hope.

The **Quagga** (*Asinus Quagga*) resembles the horse much more than the Zebra; it is striped only on the shoulders and back.

FIG. 425.—QUAGGA.

The **Onagga** (*Asinus montanus*), or Mountain Horse, is smaller than the Ass, and is marked on the head, neck, and trunk, by alternately wide and narrow black stripes, upon an isabella or bay ground. His legs and tail are white.

ORDER III.—RUMINATING QUADRUPEDS.

RUMINANTIA.*

The grand character given in the inspired volume, whereby to distinguish those quadrupeds which are specially adapted for human food, is that "they divide the hoof and chew the cud," a description so concise, and at the same time so comprehensive, that modern science has not been able to improve it. It embraces, in fact, the extensive Order of Ruminants, which next offers itself for our notice.

The animals belonging to this order are recognisable from the circumstance that they all chew the

* Ruminare, *to chew the cud.*

cud. Secondly, they have incisor teeth only in the lower jaw, generally eight in number. Thirdly, they have on each foot two toes, enveloped in hoofs which face each other by a flat side, so that they have the appearance of a single hoof, split in two or *cloven*.

The Ruminantia are large animals, without much intelligence; but which, nevertheless, render immense service to man. They furnish him with nearly all the meat that he eats; their milk supplies excellent food; they possess a fat, named suet, which is harder than that of other quadrupeds, and is applied to many purposes in the arts and domestic economy. Their skin, prepared by tanning, furnishes nearly all the leather we use; their horns, their blood, their bones, even their intestines, which are manufactured into strings, are all serviceable to us. When living, many of them are employed as beasts of burden, equally valuable in commerce and in agriculture.

This Order may be divided into two sections. The first comprises such Ruminants as are without horns; the second, Ruminants with horns, either in both sexes, or in the male only.

Ruminants without Horns.

Ruminants which are entirely without horns also differ from other Ruminants in their teeth, and somewhat resemble the Pachydermata. They are the **Camel** and the **Musk**.

The **Camels** (*Camelus*), comprehending Camels properly so called and Llamas, differ from all other Ruminantia, in having only six incisor teeth in the lower jaw. Their feet are not cloven, and have very small hoofs; the neck is very long, the limbs by no means elegant in their proportions, and their upper lips swollen and cleft. They are all remarkable for extreme gentleness and docility, and for their patience in travelling under the weight of enormous burdens. The usual load of a Camel is from six to eight hundred pounds, and with this weight upon their backs, they will travel from forty to fifty miles a day; but the swift Camels or Dromedaries carrying only a single man move with wonderful rapidity: these will traverse for several successive days, from seventy to one hundred miles in the twenty-four hours. This animal, emphatically described by the Arabian epithet the *Ship of the Desert*, furnishes the only means of

communication whereby many Eastern nations separated from each other by burning deserts carry on their commerce: his strength and capability of enduring prolonged abstinence, both from food and water, alone render this intercourse possible; and in few instances is the beneficence of the Creator more conspicuous than in the con-

FIG. 426.—ARABIAN CAMEL.

struction of these invaluable helpmates of the human race. To enable him to move with facility over a soft sandy surface, his feet are broad and cushion-shaped, and his limbs long; he picks the thorny bushes as he passes, without halting, and provided with

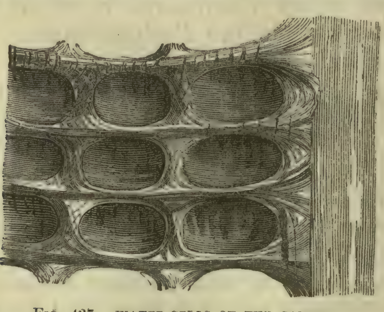

FIG. 427.—WATER-CELLS OF THE CAMEL.

an extraordinary apparatus in his stomach in which he carries water (Fig. 427), he resists the burning heat for ten or even twelve days,

without drinking; and if during this space of time his food has been still more scanty than his sober habits demand, or the few dates, beans, or cakes usually in store for him are exhausted, the fat which composes almost the whole of the hump or humps upon his back serves as an extra supply of nutriment: the humps become reduced in size; their substance reabsorbed, is taken into the general circulation, and supports him to the end of his journey, or until he sinks under privations which no other animal differently constituted could have borne for half the period. To the wild Arab of the Desert, the Camel is all that his necessities require; he feeds on the flesh, drinks the milk, makes clothes and tents of the hair; sandals, saddles, and buckets of the hide; he conveys himself and family on his back; makes a pillow of his side, and resorts to him for shelter against the whirlwind of sand. Couched in a circle around him, his Camels form a fence, and in battle an entrenchment, behind which his family and his property are obstinately, and often successfully, defended.

The **Llamas** (*Auchenia**) are the representatives of the Camels in the New World, but possess neither their strength nor size. Their proportions are lighter; they

FIG. 428.—LLAMA.

have no humps; and their toes not being joined, are sufficiently moveable to enable them to climb rocks with

* *αὐχήν*, auchen, *the throat*;—so called from their pendulous throats.

the activity of Goats. Two species are known—the *Llama proper* and the *Vicunia.*

The **Llama** (*Auchenia Llaoma*) is met with in the mountainous districts of South America. It is of the size of a Stag and covered with thick fur of a chestnut colour. At the time of the conquest of Peru by the Spaniards, it was the only beast of burden in that country, and still continues to be employed for the same purpose. Its usual load is about one hundred and fifty pounds; but it is only capable of making short journeys.

The **Alpaca**, or **Paco**, is a variety of the domesticated Llama, celebrated for its long woolly hair, which in fineness and elasticity is not much inferior to the most beautiful wool of the goats of Thibet.

The **Vicunia** (*Camelus Vicunna*) is about the size of a sheep, covered with yellow-brown wool, of admirable fineness and softness, which hangs like long silk upon its breast. It inhabits the Andes of Chili and Peru, near the line of perpetual snow; and is actively hunted on account of its wool, which is manufactured into valuable stuffs and hats.

The **Musks** (*Moschus*) differ from ordinary ruminants in the absence of horns, and in having long canine teeth in the upper jaw. They are beautiful animals, equally remarkable for their elegance and their activity.

The **Musk** (*Moschus moschiferus*) is about the size of a goat. It has no tail, and is entirely covered with hairs, so thick and brittle that they might be almost called spines.

FIG. 429.—KANCHIL.

The Musks are, however, more especially remarkable for the possession of a pouch, situated beneath the abdomen, which is filled with that odoriferous substance so well known in medicine and perfumery by the name of *musk.* This species appears to be proper to that rocky country extending between China and Thibet. It is a nocturnal and solitary animal, and its timidity is extreme.

The other Musks have no musk-pouch. They all inhabit the hot countries of the Old Continent, and are the smallest and most elegant of the Ruminants (Fig. 429).

Ruminants with Horns.

All the other Ruminants are provided (at least, the male sex) with two horns; that is to say, with projections of greater or less length, derived from the frontal bones, and which do not exist in any other animals. These horns are of three kinds.

Sometimes, as in the Giraffe, they are enveloped in a hairy skin, continuous with that of the head, and are never shed.

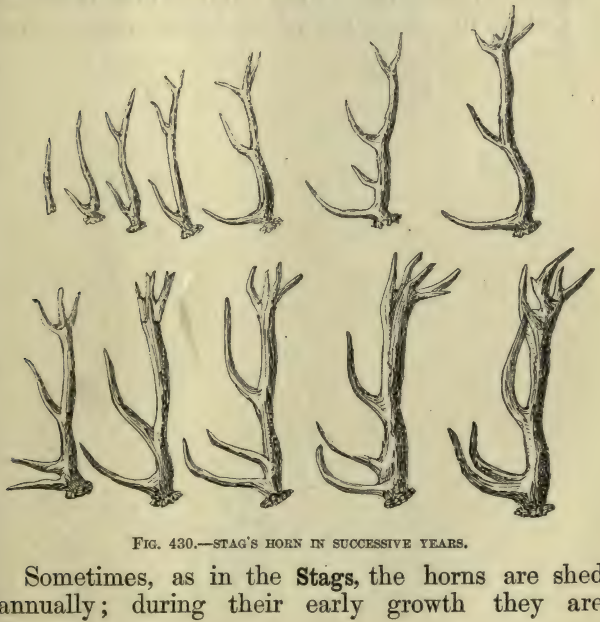

Fig. 430.—Stag's horn in successive years.

Sometimes, as in the **Stags**, the horns are shed annually; during their early growth they are

covered with a soft velvety skin; but they have at their base a prominent ring of bony protuberances, which, as they grow, compress and obliterate the nutritive blood-vessels of this skin, which then dries, withers, and is stripped off. The horns, thus laid bare, become for a season formidable weapons; but in time they separate from the skull and fall off. Soon, however, new ones begin to make their appearance, which ultimately become larger than their predecessors, but like them, are destined to be shed at the end of the year, under the influence of the same causes. Weapons of this description, purely bony, and liable to be changed periodically, are called *deciduous horns*, or *antlers*.

A third kind of horns met with in the Goat, Sheep, &c., consists of a bony *core* covered with a case of elastic substance (*horn*). Horns of this description never fall off, but continue to grow during the whole life of the animal—these are called *hollow horns*.

CLASSIFICATION OF HORNED RUMINANTS.

Ruminants with horns that are .	Deciduous (antlers) of solid bone				**STAG.**
	Permanent; covered .	By hairy skin like the rest of the head			**GIRAFFE.**
		By a horny case formed of an elastic substance analogous to that of the hoofs; the bony axis of these horns . .	Compact, without cells or pores . . .		**ANTELOPE.**
			Hollow, with cells which communicate with the nose through the frontal sinus. Horns directed . .	Upwards and backwards, forehead concave . .	**GOAT.**
				Backwards and then spirally forwards, forehead convex	**SHEEP.**
				To the side, and then upwards or forwards in the form of a crescent . .	**OX.**

The **Giraffe** (*Camelopardalis*) is distinguished from all other Ruminants by the horns, which are of a conical shape, and always covered with a hairy skin; they are never shed, and exist in both sexes. This animal is destined to browse upon the foliage and young shoots of trees at a height far greater than any other animal can reach. When standing on the ground in its wild state, it mea-

FIG. 431.—GIRAFFE.

sures, when full-grown, seventeen feet from the top of its head to the soles of its forefeet. At first view, its forelegs appear twice as long as the hinder; but this results chiefly from the extraordinary height of the shoulders. It is of a gentle disposition, and lives on the leaves of the acacia trees in the south of Africa, which it gathers by means of its prehensile tongue.

The **Stags** (*Cervus*). This genus includes all Ruminants whose males have deciduous horns on the head; but these horns are (with the single exception of the Reindeer) always wanting in the female. All these animals are extremely fleet in running; their limbs are long and slender, the body light, the coat clean and shining; in

general, they are remarkable for the beauty and elegance of their forms. Ordinarily they shed their horns in spring.

FIG. 432.—STAG.

THE RUMINANTS WITH HOLLOW HORNS

are extremely numerous, and it has been found necessary to divide them into genera, from characters of slight importance. To this section belong

The **Antelopes** (*Antelope*). These creatures very much resemble Stags in the elegance of their shape and symmetrical proportions. Of a restless and timid disposition, they are exceedingly watchful, of great vivacity, and remarkably swift and agile; their boundings are inconceivably light and elastic. Their horns, whatever shape they assume, are round and ringed; in some species they are straight, in others curved and spiral. In some the females have no horns, in others they are common to both sexes. They all possess a

most delicate sense of smell; their eyes are proverbially bright and beaming, and so fleet are they, that the hunter is often obliged to call in the aid of a falcon, trained for that purpose, to arrest their course, so that even his greyhounds may have a chance of overtaking them. They mostly inhabit torrid regions, or the hottest parts of the temperate zone, frequenting cliffs or ledges of rock, or traversing vast untrodden wildernesses. Africa appears to be their great nur-

FIG. 433.—ANTELOPE.

sery. Many kinds are natives of Asia, but it is remarkable that, notwithstanding the warmth of South America, so well suited to their nature, only a single species of Antelope is to be found in any part of the New World.

The **Goats** (*Capra*) have their horns directed upwards and backwards; their chin is generally furnished with a long beard, and their forehead concave. All these animals are robust, capricious, and of wandering habits.

FIG. 434.—GOAT.

The **Argali** (*Ovis Ammon*) is generally considered as the parent stock of all our varieties of domestic sheep. It is found in great numbers in Kamtschatka, and on the highest mountains of Barbary,

FIG. 435.—HEAD OF THE ARGALI, OR WILD SHEEP.

of Corsica, and of Greece. It is an agile, active animal, with a very delicate sense of smell, and is captured with difficulty; its flesh is much esteemed. The Argalis prefer mountainous districts, and live in dry and wild places, where they feed on coarse grass and the shoots of young trees. They are very injurious in forests. Their milk is useful as an article of food, and the flesh of the kid is eaten.

The genus **Sheep** (*Ovis*) is composed of animals whose horns are directed at first backwards, and then incline spirally more or less

FIG. 436.—SHEEP OF PALESTINE.

forwards. They have no beard, and their forehead is convex. They are so well known as to require no description.

The genus **Ox** (*Bos*) has the horns directed sideways, and then twining upwards or forwards in form of a crescent. They are all large animals, with a broad muzzle, low stature, and stout legs. They are also distinguished by a fold of skin that hangs beneath the neck, which is called the *dewlap*. They delight in moist and marshy localities, and are slow and heavy in their movements.

The **Common Ox** (*Bos Taurus*) is too well known to need description. As powerful as he is docile, the Ox is of great use in domestic economy. He draws waggons and ploughs; his flesh is eaten both fresh and salted. By boiling, his skin becomes glue; by tanning, it is converted into leather, which is chiefly manufactured into shoes; the hair is mixed with mortar, and the horns are converted into combs, spoons, drinking-cups, and various other utensils. His fat makes candles; from his blood is obtained Prussian blue, and from his intestines goldbeaters'-skin; while the milk of the cow yields us cream, butter, and cheese.

The **Auroch** (*Bos Urus*) is the largest quadruped belonging to Europe. It is distinguished from the domestic ox by its arched prominent forehead, rather broad than high, by the height of its legs, and by an additional pair of ribs. It is evident, therefore, that it

cannot be the original stock of our horned cattle. It is a fierce animal, at present confined to the great marshy forests of Lithuania and of the Caucasus, but formerly spread over all the temperate parts of Europe.

FIG. 437.—INDIAN OX.

The **Bison,** or **American Buffalo** (*Bos Americanus*), is smaller than the auroch but larger than the domestic bull. His limbs and tail are short, the forepart of his body very thick and strong, but the croup comparatively feeble; he carries a fleshy hump between the

FIG. 438.—AMERICAN BISON.

shoulders, which is considered a delicacy. His head is large, his horns round, short, and almost straight, and set wide apart at the base. A thick curly wool of a brownish-black colour, which in winter grows very long, covers his head, neck, and shoulders, while the rest of his body is clothed with smooth black hair. Although heavy in appearance, he is very swift, and of a savage disposition, but may be tamed if taken young. These animals live together in great herds, on the vast open savannahs and prairies of North America, and abound near the sources of the Missouri and Mississippi rivers, and in the neighbourhood of salt marshes.

The **Buffalo** (*Bos bubalus*) is originally from India, but has become naturalized in Egypt, Italy, and Greece; its forehead is convex, higher than it is wide, and the horns are marked in front by a longitudinal ridge. It is less docile than the ox, but more robust and more easily fed. Its skin is converted into a strong, durable kind of leather, and the horns are of a very fine grain and susceptible of high polish. The Buffalo likes to wallow in the mud; he is an excellent swimmer, and sometimes dives to a depth of ten or twelve feet, to tear up with his horns aquatic plants. This creature is with difficulty subjugated, has great strength, and prefers marshy places and coarse plants, which the ox cannot live on. There is a race of Buffaloes in India, the horns of which measure ten feet from tip to tip.

The **Cape Buffalo** (*Bos Caffer*) has very large horns directed sideways and upwards, flat and so broad at their base that they nearly

FIG. 439.—CAPE BUFFALO.

cover all the forehead. It is a very large animal, extremely ferocious, and inhabits the woods of Caffraria.

The **Yak** (*Bos grunniens*), Grunting Cow, or *Horse-tailed Buffalo* is a small species, having its tail entirely covered with long hairs,

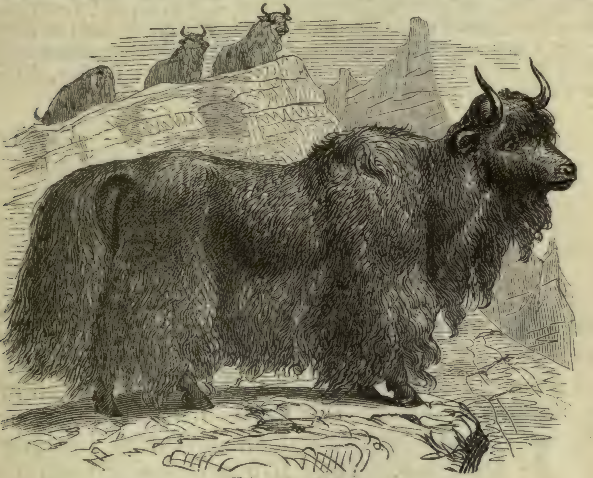

FIG. 440.—YAK.

like those of the horse. This tail still constitutes the standard used among the Turks to distinguish their superior officers.

The **Musk Ox** (*Bos moschatus*) inhabits the most northern parts

FIG. 441.—MUSK OX.

of America, under the polar circle, and climbs rocks almost as well as a goat. The horns meet at their base in front of their forehead, almost in a straight line. It stands low, and is covered with tufted hair that reaches to the ground. It diffuses a strong smell of musk, with which its flesh is also impregnated. The Esquimaux make caps of the tail, the hairs of which, falling over their face, defend them from the mosquitoes.

ORDER IV.—GNAWING QUADRUPEDS.

RODENTIA.*

The Quadrupeds that have hitherto occupied our attention, all of them herbivorous, have derived their food either from the grass of the fields or the foliage of trees, for the mastication of which their teeth are admirably adapted. The animals that next present themselves are constructed for devouring less practicable materials. They live principally upon the harder parts of vegetables, the bark, the roots, the woody stems and even the nuts and stony seeds, and are consequently provided with incisor teeth, adapted to gnaw and reduce to fragments the tough and resisting substances upon which they feed. These gnawing or *Rodent* teeth consist of four large incisors, two of which are situated in the front of each jaw; they are separated from the grinders by a wide space devoid of teeth, and are neither adapted for seizing living prey, nor cutting flesh, but are shaped like chisels, and are thus fitted for chipping off and destroying piecemeal the hardest and most intractable materials. In order that they may be better capable of such employment, these chisel-teeth are provided in front with a thin layer of enamel, hard as the hardest steel, whilst behind, they are composed of a much softer material called ivory, so that they always present a sharp cutting edge. These teeth are constantly growing from the pulpy core at their base; but as those of the upper jaw meet those of the lower at their tips, they are

* Rodo, *I gnaw.*

perpetually worn away by their action upon each other, and upon the hard food which they are formed for nibbling, so that the wearing away of the extremities and the growth from the bases

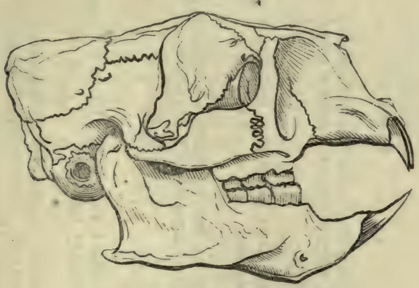

FIG. 442.—SKULL OF PORCUPINE.

balance each other with exact precision. When, however, by accident, an opposing incisor is lost, or when by the distorted union of a broken jaw, the lower incisors no longer meet the upper ones, as sometimes happens to a wounded Hare, the incisors grow until they project like the tusk of an Elephant. The Rodents are all timid and feeble, trusting for self-protection to flight or concealment. The prey of ferocious beasts, and birds, and reptiles, their fertility, by a wise provision, counterbalances their annual diminution. Spread over the earth from the equator to the coldest latitudes, they tenant rocks and mountains, plains and woods, and often devastate the cultivated domains of man. About half of the Mammalia known belong to this Order, which contains above six hundred species. Of these, three hundred and six are of the Family *Muridæ*, the Rats and Mice, while the Squirrels (*Sciuridæ*) contain exactly half that number. Fifteen species are enumerated by Professor Bell as belonging to the British Isles. The Rodentia are classed as follows:—

ORDER OF RODENTIA.	Collar-bones well developed, and extending almost from the sternum to the scapula . . .	Molar teeth with roots, which cease growing when completely formed, composed of . .	Enamel and ivory without cortical matter. Incisors	Of ordinary length. Those of the lower jaw . . .	Very compressed. Tail long and adorned with hairs . . .	SQUIRRELS.
					Pointed. Tail slim and generally with little or no hair . .	RATS.
				Very long and always uncovered. Tail very short, or wanting altogether		RAT-MOLES.
			Ivory enamel, and cortical matter .	Posterior paws palmate. Five toes throughout		BEAVERS.
				Hind paws not palmate. Number of the toes variable		JERBOAS.
		Molar teeth without roots, which continue to grow during life		Three molars throughout . . .		FIELD MICE.
				Four molars throughout. Front toes of ordinary length		CHINCHILLAS.
	Collar-bones wanting, or too short to serve as a brace or a buttress between the shoulder and the sternum .	Molar teeth without roots		Two small supplementary incisors behind the two ordinary large incisors of the upper jaw . . .		HARES.
				Without the supplementary incisors		CAVIES.
		Molar teeth with roots		Back without spines		PICAS.
				Back armed with spines		PORCUPINES.

The **Beavers** (*Castor*) are distinguished from all other Rodents by their tail, which is horizontally flattened, of a nearly oval form, and covered with scales. They have five toes on every foot, and those of the hinder feet are webbed.

The **Beaver** (*Castor Fiber* *) is an inhabitant of the most solitary parts of North America. It is also met with in Siberia and Norway. These animals are always found in the vicinity of rivers and lakes; in the summer they inhabit burrows, which they dig along the shores, but in winter they retire into huts, constructed with the greatest care, on the banks or in the midst of the water. In constructing these habitations they generally choose the deepest

FIG. 443.—BEAVER.

pools, which are not likely to be frozen to the bottom; and they prefer running streams, which enable them to cut the wood necessary for their building above the spot where they work, and then the current carries it where it is required. If the waters are stagnant they at once commence their houses, but if it is running they assemble together, often two or three hundred in a gang, and first form a shelving dam or dyke to maintain the water at an equable height. This dam is formed of branches interlaced with each other; the intervals between them being filled with stones and mud, and plastered over with a thick solid coat. It is commonly ten or twelve feet thick at the base, and is sometimes of very considerable extent, so that at the expiration of a few years it is usually covered with

* Fiber an old name for the beaver, now used as the specific name

vegetation, and thus converted into a substantial hedge. The dam being finished, they separate into small parties, and set about the construction of their huts, which are built against the dam, but with less solidity. Each hut accommodates two or three families; it has two stories, the upper one being dry, for the residence of the animals, the lower one under water, for the store of bark, upon which they feed. The entrance to this habitation is always under water. Their work is carried on in the night only, but with astonishing rapidity.

The **Rats** (*Mus*). The tribe of Rats is composed of a great number of small Rodents, which resemble our common Rats in the most important points of their economy. Their front paws have generally four toes and a tubercle representing a thumb. The hinder feet have five complete toes; most of them live in holes. The species are very numerous; amongst them we can only notice

The **Musk-rat of Canada** (*Mus Zibeticus*), of the size of a rabbit, and of a reddish-grey colour. These animals in winter construct a hut of clay on the ice, where they live in great numbers.

"The solid structure, framed with twisted reeds,
Plaster'd with mud, and intermix'd with weeds,
Four cubits measures, in its space around,
Raised like a little turret from the ground.
At top a rounded cupola or dome,
Twelve inches thick, roofs in this wintry home;
Here with their young whole families repose,
Whilst gather'd o'er them rest the winter's snows."

FIG. 444.—WATER RAT.

The **Water Rat** (*Mus amphibius*) is somewhat larger than the common Rat, of a deep greyish-brown colour, with the tail as long as the body. It inhabits the banks of streams, and digs in marshy grounds to look for roots; it is but an indifferent swimmer and diver.

The **Lemmings** (*Mus Lemmus*), a northern species, the size of a Rat, with fur diversified with yellow and black, are very celebrated for the migrations they make from time to time in innumerable troops. They are said to march in a straight line, neither river, mountain, nor any other obstacle arresting their passage, while they carry devastation into all the lands through which they pass. Their usual habitat seems to be the shores of the icy sea.

The **Dormice** (*Myoxus*—Rat with a pointed nose) are pretty little animals, with soft fur, a hairy or even tufted tail, and animated look;

FIG. 445.—DORMICE.

they live on trees, and feed on fruits; they pass the winter in a deep lethargic sleep, rolled up into a ball.

The **Rats** (*Mus Rattus*), properly so called, feed chiefly on vegetable substances, such as grains and roots; but they also devour flesh, and when forced by hunger, they mingle in fierce battle, and devour each other.

The **Hamsters** (*Mus cricetus*) have the same kind of teeth as the Rats, but their tail is short, and the sides of the mouth are furnished with wide sacs or cheek-pouches, serving to transport the grain which they carry to their subterranean abode.

The **Harvest Mouse** (*Mus messorius*) is the smallest

of our native Rodentia. Its nest is a structure which, in neatness and beauty, may be compared to the productions of birds. It is usually composed of blades of grass, woven into a globular form about as large as a cricket-ball, and so compact that it may be rolled across a table without injury. It is affixed to the stems of weeds, or, as in the engraving, to the stalks of growing corn.

FIG. 446. NEST OF THE HARVEST-MOUSE.

The **Marmots** (*Arctomys* *) have short tails, short legs, and a broad, flattened head. They pass the winter in lethargy, in deep holes, the entrance of which they stop with hay; they are sociable little creatures, and easily tamed.

The **Squirrels** (*Sciurus* †) are at once recognised by their long bushy tails: their head is large, their eyes projecting and animated, and their form light. They are all remarkable for their activity, live on trees, and feed upon fruits. They are divided into **Squirrels**, properly so called, and **Flying Squirrels**.

The **Common Squirrels** (*Sciurus vulgaris*) are lively, graceful, little animals, that inhabit woods, and make their nests upon the highest parts of the loftiest trees. They build them in a spherical form, of flexible twigs and moss, leaving an opening in the upper part, which they take care to cover with a sort of conical roof to keep out the rain. In this nest they pass a part of the day. In the evening they are gay and full of sport, jumping from branch to branch, and uttering a pretty sharp whistle. During the summer, squirrels are busy in storing up food for the winter. The trunk of a hollow tree is their usual store-house, to which they have recourse when fresh food grows scarce.

* ἄρκτος, arctos, *a bear*; μῦς, mus, *a rat—bear-rat.*

† Sciurus, *a squirrel.*

FIG. 447.—SQUIRREL.

The **Flying Squirrels** (*Pteromys* *) have on each side of the body a prolongation of their skin, extending between the fore and hind legs, and forming a parachute, by the aid of which these

FIG. 448.—ROCKY MOUNTAIN FLYING SQUIRREL.

* πτερόν, pteron, *a wing* ; μῦς, mus, *a mouse or rat—winged-rat.*

creatures make extended leaps. One species is found in the forests of Poland and Russia, and another in North America.

The **Porcupines** (*Hystrix*) are known at the first glance by the sharp spines with which they are armed. They live in burrows, and have many of the habits of Rabbits.

The **Common Porcupine** (*Hystrix cristata*) is larger than a Hare; the spines upon its back are strong and very long; there is a mane of long hair on the head and neck; the tail is short, and provided with two open tubes that make a noise when the animal shakes them.

FIG. 449.—AFRICAN PORCUPINE.

The Porcupine avoids inhabited places, and selects for its retreat stony arid hillocks with a southern aspect, in the declivities of which it excavates deep holes with many outlets, where it lives in profound solitude and great security. It passes the day concealed at the bottom of its burrow, and provides for its wants during the night only. Its chief food consists of berries, fruits, buds, roots, &c. For the Porcupine, winter is a time of sleep, but its lethargy does not seem to be very profound, seeing that it makes its appearance in the first bright days of spring. This species is commonly met with in Southern Italy.

The **Hares** (*Lepus*) have a very distinctive character in their upper incisors, which are double; that is to say, each of them has a smaller one behind it. They have five toes before, and four behind. The interior of their mouth and the under part of their feet are hairy like the rest of the body.

The **Common Hare** (*Lepus timidus*) is of a yellowish grey, the ears one-sixth longer than the head, ash coloured behind, and black at the point. Its dark flesh is good for food, and its fur is useful.

It lives isolated, does not burrow, and sleeps on the flat ground. When hunted, it describes a large circle in running.

The **Rabbit** (*Lepus cuniculus*) is less than the Hare; the ears a little shorter than the head, and the tail shorter than the thigh. This animal, originally from Spain, is now spread throughout Europe. It lives in society, in burrows, in which it takes refuge when pursued. Its flesh is white and agreeable, and differs considerably from that of the Hare. In a domesticated state, the Rabbit breeds rapidly, and becomes varied in colour and in the texture of its fur.

The **Rat Hares** (*Lagomys**) have ears of moderate length, legs but little different from each other, and are without a tail; they are found in Siberia.

The **Cavies** (*Hydrochærus* †) have four toes before and three behind, armed with large nails, and webbed. But one species is known, namely,

The **Capybara** (*Hydrochærus capibara*), as large as a small pig, with a very thick muzzle, short legs, and without any tail. It lives in troops in the rivers of Guiana and the Amazons. It is the largest of the Rodentia; the Beaver only at all approaches it in size.

The **Guinea Pigs** (*Anæma*) resemble Capybaras in miniature, but

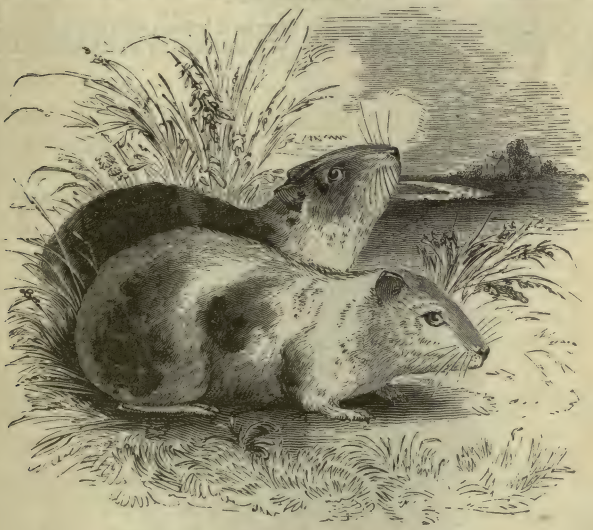

FIG. 450.—GUINEA PIGS.

their feet are not webbed. We know but one species, now much bred in Europe, because their odour is thought to drive away Rats. They are found in the woods of Brazil and Paraguay.

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* λαγώς, lagōs, *a hare;* μῦς, mus, *a rat.*

† ὕδωρ, udor, *water;* χοῖρος, choiros, *a hog.*

FIG. 451.—AGOUTI.

The **Agoutis** (*Chloromys*) have four toes before, and three behind. They seem to represent our Hares and Rabbits in the Antilles, and in the hot parts of America.

FIG. 452.—JERBOA.

The **Jerboas** (*Jerboa*). This tribe consists of a small number of Rodents that considerably resemble rats. The tail is long and tufted at the end; but they are most remarkable from the structure of the posterior extremities, which, in comparison with the anterior, are of immoderate length They are met with from Barbary to the coasts of the Caspian Sea.

Order V.—Toothless Quadrupeds.

Edentata.*

The teeth of quadrupeds are simply mechanical instruments, adapted to obtain and to prepare the food for digestion, and are, consequently, modified in their construction, in accordance with the aliment. To animals which live exclusively upon the foliage of trees, the possession of incisor teeth would be useless, and to others that feed upon such materials as do not require mastication, teeth of any kind would be superfluous. To quadrupeds thus circumstanced, Cuvier has therefore given the general name of **Edentata**, apparently implying that animals so designated are entirely deprived of teeth, as, indeed, is literally the case with some species, but in others teeth do exist, though of a very peculiar structure. *They all, however, agree in having no front or incisor teeth.*

The Order **Edentata**, therefore, includes all quadrupeds provided with separated toes, that are without incisor teeth in either the upper or lower jaw.

Although associated by a character purely negative, the animals thus designated present many points of relationship. Their toes are enveloped in very large and strong nails, upon which they walk with difficulty, and all of them exhibit a slowness, and want of agility, obviously caused by the structure and position of their feet. There are, however, certain intervals in these relations by which the Order may be divided into the following tribes:—

* Edentata, *toothless.*

The **Sloths** (*Bradypus* *). When on the ground nothing can be more awkward, more misshapen and more powerless than the Sloths. Their short, ungainly body is supported on limbs of such unequal length, that in order to walk, these animals are obliged to lean on their elbows; and their thighs are turned outwards to such an extent, that they cannot bring their knees together. Moreover, their hind

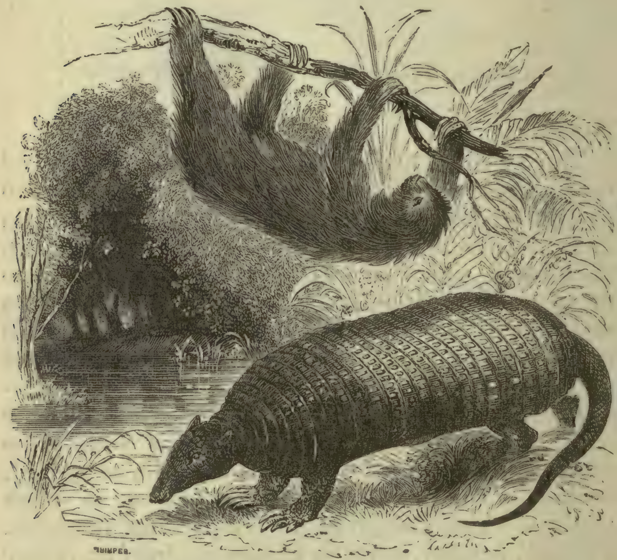

FIG. 453.—THREE-TOED SLOTH, AND GIANT ARMADILLO.

feet are united to the legs in such a manner, that they only touch the ground by their outer edge, and their toes are so joined together by the skin, that nothing is seen of them but their enormous hooked nails, and these possess so little movement, that at a certain age, they become completely soldered, as it were, to the bones of the foot. When they sit upright, which seems the position least inconvenient to them, their mouth is directed straight upwards, so that it is very difficult for them to graze on the ground; and if we add to this the extreme slowness of their movements, to which they are indebted for the name they bear, we might almost be tempted to agree with the expression of Cuvier, that in constructing these animals "nature seems to have amused herself by the production of something imperfect and grotesque."

It is not, however, upon the ground that the habits of the Sloth are to be criticised; its home is on the trees, where, amidst the dense forests that border the mighty rivers of South America,

* βραδύς, bradus, *slow, heavy*; πόυς, pous, *a foot—slow-footed.*

it lives entirely upon the foliage, the buds, and the young shoots. To this singular mode of life, the structure of the Sloths is adapted with the same consummate wisdom and skill which are manifest in all other works of God. The Sloth spends his whole life in the trees; and what is more extraordinary, not *upon* the branches, but under them—he rests suspended from a bough, and he sleeps suspended from it. To enable him to do this, he must have a very different formation from any other quadruped. There is a saying among the Indians, that when the wind blows, the Sloth begins to travel. In calm weather he remains tranquil, probably not liking to cling to the brittle extremities of the branches lest they should break with him in passing from one tree to another; but as soon as the wind rises the boughs of the neighbouring trees become interwoven, and then the Sloth seizes hold of them, and pursues his journey in safety. He travels at a good round pace, and as he swings himself from tree to tree with indefatigable industry, seems little to merit the commiseration generally extended to him by writers who have never seen him in his state of activity.

The **Armadillos** (*Dasypus* *) are remarkable amongst all other quadrupeds, by having the head, body, and often the tail, covered by a hard stony coat, arranged in compartments something like a mosaic pavement. This substance, which may be considered a kind of agglutinated hair, forms a broad buckler over the forehead, a

FIG. 454.—WEASEL-HEADED ARMADILLO.

second, very large and convex over the shoulders, a third, similar to the preceding, on the crupper; and between these two last, there are several parallel and moveable bands which allow the body to be bent. The tail is sometimes furnished with successive rings, sometimes, like the legs, only with detached pieces. These animals have large ears, sometimes four, sometimes five toes on their fore feet,

* δασύς, dasys, *hairy*; πούς, pous, *a foot—hairy-footed.*

but always five on the hinder. Their tongue is soft, and but little extensible; a few hairs are scattered between the plates of their armour, or in those parts of the body where these plates are deficient. The Armadillos vary in size, from that of a terrier dog, to that of a hedgehog. They are stout in their body and low on their legs; they dig burrows, and feed partly on vegetables, partly on insects and dead animals. They belong to the warm, or at least the temperate, parts of America.

The **Ant-eaters** (*Myrmecophaga*) inhabit the same countries as the Armadillos, from which, however, they are readily distinguished. Their body is hairy, and their muzzle, drawn out into a long, cylindrical tube, is terminated by a small mouth, entirely destitute of teeth. In consequence of the smallness of their mouth, their jaws can scarcely be separated from each other, nor can the creatures use them to seize or compress their food; but they are provided with a very long tongue, which, when extended, resembles a great earth-worm : this they are able to protrude to a considerable distance, and as it is always covered with a viscid tenacious slime, they use it for the purpose of catching the ants upon which they feed. By the assistance of their long and powerful nails, the Ant-eaters tear up the nests of the Termites or White Ants, and at the moment when these insects sally forth in crowds from their retreat, protruding amongst them their viscid tongue, seize them by hundreds, and thus convey them into their mouth. When at rest, the claws, that serve also as defensive weapons, are folded against the wrist, so that as the animal only rests the foot upon the side, its gait is slow. Some species are furnished with a prehensile tail, by which they suspend themselves from the branches of trees. The largest of the tribe,

FIG 455 —GREAT ANT-BEAR.

The **Tamanoir, or Great Ant-Bear** (*Myrmecophaga* * *jubata*), does not possess this faculty; it is upwards of four feet long; its tail is furnished with long hairs, directed vertically both above and below. It is said that it can defend itself against the Jaguar. It is a native of Brazil and Guiana. It might seem almost incredible that so robust and powerful an animal can procure sufficient sustenance from Ants alone; but it is not surprising to persons acquainted with the tropical parts of America, and who have seen the enormous multitude of these animals, that swarm in all parts of the country to such a degree, that their hills almost touch one another for miles together. The favourite resorts of the Great Ant-eaters are the low swampy savannahs along the banks of rivers and stagnant waters.

The **Scaly Ant-eaters** (*Manis* †) differ from the preceding by having their body, limbs, and tail covered with thick scales, disposed

FIG. 456.—MANIS.

like the tiles of a house, these they raise, by rolling themselves up into a ball, to defend themselves against an enemy.

The **Cape Ant-eaters** (*Orycteropus* ‡) have long been confounded with the Ant-eaters, because they live on the same kind of food,

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* *μύρμηξ, μύρμηκος*, murmex, murmekos, *an ant*; *φαγεῖν*, phagein, *to eat—ant-eater.*

† Probably from manus, *a hand,* on account of the large fore-claws, which are employed in tearing down the nests of the Termites or White-ants.

‡ *ὀρυκτής*, oryctes, *a digger*; *πόυς*, pous, *a foot.*

have the head similarly formed, and the tongue long and extensible; but they are distinguished by having cheek-teeth and flat nails. The structure of their teeth is different from that of all other quadrupeds; they are cylindrical in shape, and traversed with an infinite number of little canals, like the pores of a cane. There is but one species.

The **Ground Hog** (*Orycteropus Capensis*) inhabits burrows, which it digs with great facility.

With the exception of the human race, and a few domestic animals specially intrusted to the care of man, no animal is permitted, in a state of nature, to arrive at old age—that is, such old age as permits decline and feebleness to usurp the place of strength and vigour. Man only, indeed, is capable of such a privilege, inasmuch as he alone is possessed of that foresight and intelligence which enables him, in the days of his youth and activity, to provide for the wants of his declining years, or trust to his social position for assistance and support.

Wherever else we look throughout the broad creation, violent death awaits alike all living things. Do the feebler animals betray a lack of cunning or a want of speed? The destroyer is at hand; the executioner is at the door. Does the tyrant fail in strength or courage to pursue its prey? The foe awaits it, and its doom is fixed. No maudlin pity interferes with this dread duty.

Decay, disease, decline, decrepitude, are not allowed to sully Nature's works, except where man, permitted for a moment, interferes. The agents thus employed to destroy and live upon the flesh of other animals, are grouped together under the general name of **Carnivora** or **Flesh-eaters**, and are the most highly gifted and intelligent of the brute creation.

Order VI.—Carnivorous Quadrupeds.

Carnivora.*

Although the epithet *carnivorous* is strictly applicable to many of the preceding quadrupeds, yet their diet is for the most part confined to small animals, such as worms and insects, as the general feebleness of their structure and the arrangement of their teeth alike indicate. But in the Order, upon the consideration of which we are now about to enter, the sanguinary appetite is conjoined with strength necessary for its gratification. The carnivorous quadrupeds, properly so called, are at once distinguishable by the possession of four large, long, and widely-separated fangs, generally known by the appellation of *canine* or *dog-teeth*, the use of which is to seize and hold fast their struggling prey; between these there are six smaller teeth, in the front of each jaw, called *incisors*, while the cheek-teeth are either entirely constructed for cutting and tearing, or have their crowns more or less blunted. They are more exclusively carnivorous in proportion as their teeth are more completely trenchant; and such as live also upon vegetable food may be recognised by the bluntness of their grinders. Thus, in the Cats, the most bloodthirsty of the race, the cheek-teeth are flat and triangular, and their edges cut like the blades of a pair of shears; whilst, on the other hand, the Bears, most of which feed largely on vegetable substances, have nearly all these teeth adapted for bruising and crushing.

Fig. 457.—Skull of Tiger.

* Caro, carnis, *flesh*; voro, *to devour*.

The teeth next to the canines are named *false molars ;* to these succeeds a tooth of great size, called a *lacerator*, and behind these are others of smaller dimensions, which are generally more or less blunted, called *blunt molars*. Those genera that are provided with the fewest false molars will, of course, have their jaws proportionately short, and, consequently, stronger and more vice-like in their action.

But, beside these differences in the teeth of the carnivora, they differ remarkably in the structure of their hinder feet. Some of them, in walking, place the entire sole of the foot upon the ground, and this part is destitute of hair, whilst others walk only upon the tips of their toes, the hinder part of the foot or *tarsus* being raised from the ground and hairy; the former are called **Plantigrade**, and the latter **Digitigrade Carnivora.**

Plantigrade Carnivora.

The **Bears** (*Ursus*) have three large blunt molar teeth in each jaw, in front of which is a small lacerator, preceded by a variable number of very small false molars; they consequently live almost entirely upon vegetable food, and seldom eat flesh by choice. They lay the

Fig. 458.—Bear.

whole sole of the foot upon the ground in walking, which gives them a heavy, shuffling gait, but admits of the body being reared up, and sustained in an erect attitude; in this posture the fore-paws are frequently used in defence, either to strike or to hug an assailant to death. The feet are furnished with five toes, armed with strong curved and blunt nails. They are generally large animals, with thick-set bodies, clumsy limbs, and a very short tail; they dig for themselves dens, or construct shelters, in which they pass the winter, in a state of profound sleep, without taking food, and it is in these retreats that the female rears her cubs, usually two in number.

The **White Bear** (*Ursus maritimus*) is an animal of very peculiar habits. It lives in the frozen regions of the northern hemisphere, where it feeds on fishes, seals, and young whales; nevertheless, even this animal is not essentially carnivorous, and can be brought to live on bread alone. He swims and dives with astonishing facility. White Bears are sometimes met with in numerous

FIG. 459.—POLAR BEAR.

societies, in which they differ from other Bears, which are always solitary: like the rest of the genus, however, they require a retreat for the winter; they content themselves with some cleft in the rocks, or even in a mass of ice, and there, without preparing any bed, allow themselves to be covered by enormous heaps of snow: in this way they pass the months of January and February, in a state of profound lethargy.

The **Racoons** (*Procyon* *) might almost be taken for bears in miniature, except that they are furnished with long tails, are better

* προκύων, procyon, *one who snarls like a dog.*

climbers, and more carnivorous. They inhabit the forests of North America, where they live upon eggs and small birds. They are remarkable for their singular instinct of never eating anything until they have plunged it into water.

The **Badgers** (*Meles*) are likewise plantigrade animals of nocturnal habits. Their tail is short, and their toes much concealed by the skin of their feet; but they are principally distinguished by a pouch situated under the tail, which furnishes a fatty fetid secretion. Their fore-claws are very long, enabling them to dig in the earth.

The **Common Badger** (*Meles Europea*), found in all the temperate regions of Europe and Asia, lives at the bottom of a tortuous hole obliquely excavated in the ground, and is about the stature of a middle sized dog. Formerly the hunting of this animal was a

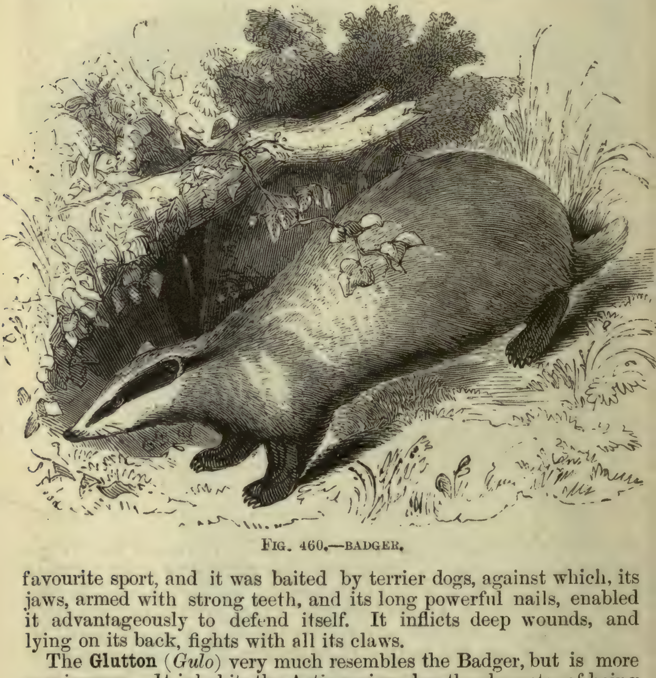

FIG. 460.—BADGER.

favourite sport, and it was baited by terrier dogs, against which, its jaws, armed with strong teeth, and its long powerful nails, enabled it advantageously to defend itself. It inflicts deep wounds, and lying on its back, fights with all its claws.

The **Glutton** (*Gulo*) very much resembles the Badger, but is more carnivorous. It inhabits the Artic regions, has the character of being very cruel, hunts by night, and is said to overcome animals of large size by leaping upon them from a tree. Its name has been derived from exaggerated accounts of the voracity of one species, the *Wolverine*, of North America. It is said not to hybernate during the winter.

Digitigrade* Carnivora.

The **Digitigrades**, as we have seen above, are distinguished by walking on the ends of their toes. They may be divided into several groups as follows:—

DIGITIGRADE CARNIVORA.

- Having one or two tuberculous teeth behind each carnivorous tooth (lacerator), in the lower jaw . .
  - One tuberculous tooth behind each carnivorous tooth . .
    - False molars more numerous in the lower than in the upper jaw . .
      - Three above and four below. Nails sharp . . . . . . — **MARTENS.**
      - Two above and three below . .
        - Nails sharp, toes united for three-fourths of their length by a palmate skin . . — **POLECATS.**
        - Nails of the fore-paws long, and used for digging — **SKUNKS.**
    - Three false molars in each jaw (on each side), toes united to their extremities by a palmate membrane; tail flattened horizontally . . — **OTTERS.**
  - Two tuberculous teeth behind the carnivorous tooth of the upper jaw . .
    - Two tuberculated teeth both above and below; tongue smooth; nails not retractile . . . — **DOGS.**
    - A single tuberculated tooth behind the carnivorous tooth in the lower jaw; tongue rough; nails semi-retractile . . . . . . — **CIVETS.**
- Not having a tuberculous tooth behind the carnivorous tooth in the lower jaw . .
  - Three false molars in each jaw; tongue rough; nails short, suitable for digging, and semi-retractile . . . . . — **HYÆNAS.**
  - Two false molars in each jaw; nails retractile . . . . — **CATS.**

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* Digitus, *the toe;* gradior, *I walk—walking on their toes.*

Those that are provided with but a single blunt-molar behind the lacerator, form a very natural family, distinguished by the name of **Vermiform Carnivora,** or in English *Vermin* (*Vermes, a worm*), on account of their long slender bodies and short legs. They have five toes on all their feet, and exhale an odour, more or less strong, which proceeds from a liquid furnished by two glands situated under the tail. Although of small dimensions, these animals are very cruel, and live principally upon the blood of their victims. To this group belong the *Martens, Polecats, Skunks, and Otters.*

The **Polecats** (*Putorius*) are the most sanguinary of all; their head is round, and their short muzzle extends beyond their mouth; their ears are rounded, and much wider than long, their fur is thick and soft, their tail is long, and the glands beneath it secrete a horribly stinking fluid. Their mode of life is solitary and nocturnal. They are found both in the Old and New World.

The **Common Polecat** (*Mustela putorius*) is brown, with yellowish flanks, and white spots on the head; it is fifteen to eighteen inches in length, exclusive of the tail, which is six inches long. It takes up its abode in the thatch of barns, and other unfrequented places, from which it sallies forth at night in search of prey; it glides into poultry yards, and mounts into dove-cotes, where, without making much noise, it commits sad havoc, biting off the heads of the sleeping birds, and carrying them away. In the country these animals destroy great quantities of game; they establish themselves in rabbit-burrows, in clefts of rocks, or in the trunks of hollow trees, whence they come forth by night to prowl in the fields. In the woods they seek the nests of partridges, and even climb trees in search of prey; they devour rats, moles, and field mice, and wage a constant war against rabbits, which they pursue into their holes.

The **Ferret** (*Mustela furo*) very much resembles the Polecat, but its body is more elongated and slender, its head narrower, and its muzzle more pointed; its colour is a dun or yellowish-brown. This animal is originally from Barbary; it has become naturalized in Spain; but in this country it is only domesticated. It is employed to hunt rabbits. When let into a rabbit burrow, it is muzzled, that it may not kill the rabbits in their hole, but only compel them to come out, when they are caught by a net placed at the entrance.

The **Weasel** (*Mustela vulgaris*) is of a chestnut-brown colour above, white below, and in length about six inches, with the addition of an inch and a half for the tail. In its general habits it resembles the Polecat, and is equally destructive to poultry and game. In winter it usually takes up its abode in granaries, or

in barns, frequently remaining there till the spring, to give birth to its young among the hay or straw; in such situations it wages war more successfully than a cat against rats and mice, which cannot escape because it follows them into their holes. In the spring

FIG. 461.—WEASEL.

it is to be found along the banks of rivers and brooks, and conceals itself in thickets, where it catches birds. It is generally by a single bite through the skull, piercing the brain, that Weasels destroy their victims.

The **Ermine** (*Mustela erminea*) is another species of Polecat. Its body is about nine inches long, and its tail about four. This little animal has two coats. In winter it is white, with its tail tipped with black, and bears the name of Ermine, but during the spring it changes to a beautiful brown above, and yellowish white beneath; it is then called the Roselet. It is found in the northern parts both of the old and new continent. The winter skins are much sought after as furs, and form a considerable article of commerce.

The **Martens** (*Mustela*) differ slightly from the true Polecats in the structure of their teeth, and their more elongated muzzle: the species are very numerous, and are scattered over both continents; among them we can only notice

The **Sable Marten** (*Mustela Zibelline*), so celebrated on account of the richness of its fur. It inhabits the northern parts of Europe and Asia, and abounds most in the mountains of frozen countries, the intense cold of which renders them uninhabitable by man. As it is the winter coat only that is so highly prized, the pursuit of the Sable is, of all kinds of hunting, the most arduous and perilous.

The **Skunks** (*Mephites* *) are celebrated for their intolerable stench, which they diffuse to a great distance. They inhabit North America.

The **Otters** (*Lutra*) possess a peculiar physiognomy, which prevents them from being confounded with any of the neighbouring genera. Destined to pursue and to feed on living fishes, they are aquatic animals, and furnished with means of swift progression beneath the water. Their body is long but flattened, and capable of much flexibility in swimming. The feet are broad and webbed, and the tail flattened horizontally, forming a rudder. Their coat is very thick, and formed of two sorts of hairs, one silky, the other woolly; the

Fig. 462.—Otter.

silky is long, stout, hard, and shining, and the hairs thicker at the point than at their base; the woolly is short and compact, forming an extremely soft fur. These animals live chiefly upon fish, after which they dive with peculiar ease and swiftness, capturing their slippery prey with unerring skill. The result of their fishing is always brought on land to be devoured, and the head bitten off as the first mouthful. They inhabit bye-places, and sequestered nooks on the banks, or in the neighbourhood of water; here they make a bed of dry grass, and remain concealed during the day, it is only at night, that they issue forth in search of food.

The **Sea Otter** (*Mustela lutris*) is twice as large as the common Otter; and its black coat of the vivid brightness of velvet forms one of the most precious furs. This species inhabits Kamtschatka, the

* Mephitis, *a noxious exhalation.*

most northern parts of America, and the neighbouring islands; generally it keeps by the seaside, and not within reach of fresh water.

The second group of **Digitigrade Carnivora** is characterized by having two blunt molars behind the *lacerator* of the upper jaw, and comprehends the least sanguinary animals of this order. They are of moderately large stature, but their courage does not equal their strength, and they generally feed on carrion. This group includes the **Dogs** and the **Foxes.**

The **Dogs** (*Canis*) have their tongues smooth; their front feet are provided with five fingers, while the hinder have only four.

The **Domestic Dog** (*Canis familiaris*) is distinguished by its recurved tail; in every other particular, such as size, form, colour, and the quality of its hair, it is infinitely diversified. The conquest over this race of animals is the most complete, the most wonderful, and the most useful ever achieved by mankind. The entire species has become his own property; every individual is devoted to its particular master, assumes his manners, knows and defends his property, and remains attached to him till death; and all this neither from constraint nor want, but solely from gratitude and pure friendship. The swiftness, strength, and scent of the Dog, have rendered him a powerful ally to man against any other animals, and were even, perhaps, necessary to the establishment of society. It is the only animal that has accompanied mankind over the whole world.

The eyes of the new-born Dog are closed, and become opened about the tenth or twelfth day after birth; the first set of teeth are shed when it is about four months old, and its growth is completed in two years.

The **Wolf** (*Canis lupus*) is distinguished from the Dog by his

FIG. 463.—WOLF.

straight tail and his colour of tawny grey. This much-dreaded pest of many European countries lives a solitary life, and does not associate with his fellows, unless pressed by hunger, when, becoming reckless and furious, they join together in packs, and commit terrible depredations among sheep and cattle. The bite of the Wolf is so ferocious, that he is said usually to bring away the flesh upon which he has fastened his jaws; his natural disposition, however, is sullen and cowardly, and it is rarely that he ventures to attack his equals in strength.

The **Foxes** (*Canis vulpes*) are distinguishable from Dogs and Wolves by their tail, which is longer and more bushy, by their muzzle, which is more pointed, and by the pupils of their eyes, which in the daytime form a vertical slit; they diffuse a suffocating stench, dig holes in the earth wherein they reside, and only attack animals much weaker than themselves. The common Fox has rendered himself famous for his tricks and cunning. He generally establishes his abode on the edge of a wood in the neighbourhood of

Fig. 464.—Fox.

some farm. If he gets entrance into the poultry yard, he slaughters all the fowls, and, loading himself with a part of the spoils, he hastens to hide his booty at some distance; he then returns, and carries off another portion, which he disposes of in the same way, taking care, however, to change the place of deposit: this he repeats several times. His gluttony, however, will accommodate itself to much less dainty food. When pressed by hunger he will eat rats and mice, snakes, toads, and lizards, and even content himself with vegetables.

The **Civets** (*Viverra*) seem to complete the chain of relationship between the Dogs and the Cats: like the last, their tongue is rough, and their claws retracted whilst walking, so that they are always sharp. These animals are provided with a pouch situated under the tail, containing a greasy substance, that frequently exhales a strong odour.

FIG. 465.—CIVET.

The **Civet,** properly so called (*Viverra Civetta*), often erroneously named the Musk-cat, yields a scent that formerly enjoyed a high reputation. It is a native of Guinea, and the central parts of Africa, but can live in temperate and even in cold climates, and has been acclimatized in Holland, where the inhabitants carry on a considerable trade in its perfume.

The **Ichneumon,** or **Pharaoh's Rat** (*Viverra Ichneumon*), is distinguished by its large eyes, with pupils elongated transversely; it is larger than our domestic Cat, but slender like the Weasel, and of a greyish colour. This animal is the famous Ichneumon worshipped by the ancient Egyptians, probably on account of the service it renders by destroying great numbers of the eggs of the Crocodile; it lives, however, upon all sorts of small animals, and is kept in houses for the purpose of killing mice and other unwelcome intruders.

The last group of Digitigrade Carnivora is distinguished by having no small teeth whatever, behind the lacerators in the lower jaw. In this group are found the most cruel, the most carnivorous, and, on account of their strength, the most formidable of

the tribe. They have been separated into two genera, the **Hyænas** and the **Cats**.

The **Hyænas** (*Hyœna*) are distinguishable from the Cats by having only four toes, both on their front and hind feet, by their claws, which are not retractile, and by the position of their teeth, which are so powerful,

FIG 466.—HYÆNA.

that they can crack the shin-bone of an ox. Their coat is rough, not thick, but composed of long hairs that form a mane down the middle of the back. Their gait is singular; they step out in front, and always seem to drag the hind legs after them. These animals are nocturnal in their habits; they live in caverns and old ruins. They are exceedingly voracious, and feed more especially on dead carcases.

The **Cats** (*Felis*) are the most formidably armed of all the Mammalia. Their body is lithe and agile, their spine very flexible, their limbs muscular, but capable of free, rapid, and energetic movements. The toes are provided with strongly curved and sharp claws, which are kept from being blunted by a very curious contrivance. Their

skull is short and rounded, and beset externally with long ridges, for the attachment of powerful muscles; their jaws, which are short, and of great strength, are furnished with teeth few in number, but of the most trenchant and formidable character, and move upon each other with a vertical cutting action. Their tongue is covered with numerous horny spines, set in close array, and directed backwards, so as to form a kind of rasp, with which the animal scrapes the flesh on which it is feeding from the bones.

The mechanism whereby the points of the claws are kept from injury is extremely beautiful. Every one who has handled the velvet paws of a Cat is aware that, in its ordinary condition, the claws are quite concealed, but that, at the will of the animal, they are forcibly thrown forwards. This is accomplished in the following manner: —The last joint of each toe, the end of which is encased

FIG. 467.—TOE OF LION; *a*, with the claw extended; *b*, *c*, without the skin, retracted and extended.

by the claw, is, when at rest, drawn back, either upon or at the side of the preceding joint, by the force of two elastic bands, as represented in the accompanying figure (Fig. 467 *b*); from this position, however, it is plucked in an instant by the tendon which bends the toe, and which is attached to the base of the claws (Fig. 467 *c*), so that it is protruded ready for action (Fig. 467 *a*); when the contraction ceases, the claw again springs back to its place, and lies concealed beneath the hair at the back of the foot. The silent tread of the Cats is partly owing to this structure, and partly to the elastic pads with which

the foot is provided: these likewise serve to break the shocks to which their violent leaps would otherwise expose them.

The Cats do not hunt or pursue their prey, but lie in wait at the spots to which their victims are known to resort, hidden in some covert whence they spring upon the unsuspecting animal with irresistible force, and with one stroke of the fore-paw, fell it to the ground.

Foremost of this extensive genus stands

The **Lion** (*Felis leo*), distinguished by its uniform tawny colour, the tuft of hair at the end of its tail, and the mane which covers the head, neck, and shoulders of the male: this is the strongest and most courageous of all animals of prey. Formerly the species was diffused over the three divisions of the old world, but at present it seems almost confined to Africa, and some neighbouring parts of Asia. The majestic air, proud look, and noble gait of the Lion at once proclaim him monarch of the deserts, where he reigns supreme, and uncontrolled. His strength is prodigious; with a single blow

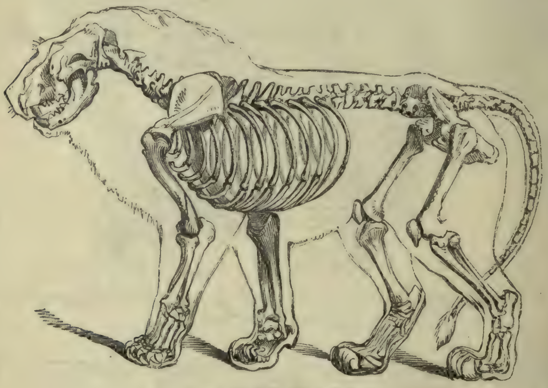

FIG. 468.—SKELETON OF LION.

of his paw he will break the back of a horse; he can clear at a bound a space of thirty feet, and drags to great distances even the largest bullocks. His terrible roar resounds through the mountains like rolling thunder, and startles his trembling prey from their concealment. This roar is hollow and deep, but when infuriated, he utters another cry, not less frightful, but short, broken, and reiterated. Nothing can be more dreadful than the appearance of the Lion when he prepares for combat. He lashes his flanks with his long tail, his mane becomes erect and bristling, enveloping his whole head, his enormous eyebrows half conceal the pupils of

his flashing eyes; he bares his teeth, and shows his spine-clad tongue, at the same time protruding his claws, which are as long as a man's finger. The Lioness is destitute of a mane; she goes with young five months, and produces but one brood in the year;

FIG. 469.—LION.

her whelps are generally from two to four in number; the parent nurses them with great assiduity, and attends them on their first excursions in search of prey.

The **Royal Tiger** (*Felis Tigris*), the scourge of India, is as large as the Lion, but with a more elongated body and rounder head, of a bright tawny colour above, and pure white underneath, with irregular black stripes across the back. Its strength and the rapidity of its movements are such that, during the march of an army, it has been known to snatch a horseman from his saddle, and carry him off into the recesses of the woods, without the possibility of rescue. The Tiger's mode of seizing his prey is by concealing himself from view, and springing with a terrific roar upon his victim, which he carries off, and tears to pieces, after having first sucked the blood. The Tigress produces four or five young at a litter. When robbed of her cubs, her rage knows no bounds; braving every danger, she pursues her plunderers even to the very gates of buildings, and when the hope of recovering them is lost, she expresses her agony by hideous and terrific howlings.

FIG. 470.—TIGER.

The **Jaguar**, or **American Tiger** (*Felis onca*), is nearly as large as the Oriental Tiger, and almost as dangerous. It is of a bright tawny

FIG. 471.—JAGUAR.

colour above, marked along the flanks with four rows of black rings, with a black spot in the middle of each. Underneath it is white, marked across with black stripes. Some individuals are

black, on which the spots, of a still deeper hue, are only visible in certain aspects. It swims and climbs with ease, and preys not only on the larger domestic quadrupeds, but also on birds, fish, tortoises, turtles' eggs, &c. It must, however, be very hard pressed before it will attack man.

The **Panther** (*Felis Pardalis*) is fawn-coloured above, white underneath, with six or seven ranges of black patches, resembling rosettes, that is to say, each composed of an assemblage of five or six simple black spots. It very much resembles the **Leopard**, which inhabits the same regions. It is one of the wildest of the feline tribe, always retaining its fierce aspect and perpetual growl. The female carries her young nine weeks; they are born blind, and continue so for nine days.

The **Leopard** (*Felis leopardus*) resembles the Panther, but has ten

FIG. 472.—LEOPARD.

rows of spot, which are of smaller size. Its habits may be gleaned from the following anecdote :—

"I was awakened with a start by an unearthly roar as of some animal in extreme terror and agony, and saw, at a little distance, a wild bull, on whose neck was crouched a Leopard. Vainly the poor beast tossed, ran, stopped, roared, and yelled. In its blind terror, it even rushed against a tree, and nearly tumbled over with the recoil. But, once more anguish lent it strength, and it set out on another race. The exciting spectacle lasted but a minute; the bull was lost to my sight, and presently his roars ceased. Probably the Leopard had sucked away his life, and was now feasting on the carcase."—*Du Chaillu.*

The **Lynx** (*Felis Lynx*), or the mountain Cat, is remarkable for the brush of hair that tips the ears. It is about two feet and half long, to the origin of the tail; its coat is red, spotted with brownish red.

It is indigenous to temperate Europe, but has almost entirely disappeared from populous countries. It is still met with in the Pyrenees, in the mountains of the kingdom of Naples, and in Africa. It climbs the highest trees of the forest, and there lies concealed among the branches, to watch the Weasel, Ermine, Squirrel, &c. It commits great havoc among flocks, and destroys a great number of hares and game. Its sight is so piercing that the ancients attributed to it the faculty of seeing through stone walls; it may, however, be asserted with truth that it distinguishes its prey at a greater distance than any other carnivorous quadruped.

The **Common** or **Domestic Cat** (*Felis Catus*) is originally from the forests of Europe. In its wild state it is greyish-brown, with transverse undulating stripes of a deeper colour above, and pale below; the inside of the thighs and the forepaws yellowish, and the tail annulated with black. When domesticated, it varies in the colour, fineness, and length of its hair, as everybody knows.

The **Amphibious Carnivora** constitute the third and last group of flesh-eating Mammalia. Their feet are so short, and so much enveloped in the skin, that they are but of little use on dry land; but as the

FIG. 473.—FOOT OF THE SEAL. *a*, SKELETON OF THE SAME.

intervals between the toes are strongly webbed, they form admirable oars. These animals, therefore, pass the greater part of their life in the sea, and seldom come on shore, except to bask in the sun, and suckle their little ones. Their elongated bodies, the flexibility of their spine, their hair smooth, and tightened, as it were, against the skin, are properties which, combined together, make them excellent swimmers. They are divided into two groups, the **Seals** and the **Morses**.

The **Seals** (*Phoca*) have their canine teeth of ordinary size, five toes on all their feet, those of the fore-feet decreasing gradually from the thumb or great toe to the little one; while on the hind feet the great and the little toe are the longest, and the intermediate ones are the shortest. The head of the Seals resembles that of a dog, and they possess the mild and intelligent countenance characteristic

of that animal. They live upon fish, always eat in the water, and can close their nostrils when they dive, by means of a kind of valve. Seals exist in great numbers in the Arctic Seas, and are the principal support of the Greenlanders and Esquimaux of Labrador, who live on their flesh, and clothe themselves, make their summer huts, and build their boats with their skins. The chase of the Seal is their principal business, and success in this pursuit forms at once their fortune and their glory.

The **Morses**, or **Walrus** (*Trichecuse**), resemble the Seals in the limbs and general form of their body, but differ much in the shape of their head and teeth. Their lower jaw is without either incisors or canines, but two enormous canine teeth or rather tusks grow from the upper

FIG. 474.—HARP SEAL AND WALRUS.

jaw and project downwards. These remarkable tusks are sometimes two feet in length, and of proportionate thickness; their chief use seems to be to enable the animal to detach from the ground the substances upon which he feeds, and to assist him in climbing out of the water on to the rocks where he sleeps. The Walrus inhabits the icy seas, it surpasses the largest ox in the thickness of its body, which is covered with a smooth and yellowish hair, and attains even to twenty feet in length. Its oil is in great request, and the ivory of its tusks, which is much employed in the arts.

* *θρίξ, τρίχος*, thrix, trichos, *hair*—from the long wiry hair of the muzzle.

Order VII.—Insect-eaters

Insectivora.*

When we reflect upon the infinite numbers of insects, and their wide dispersion, the abundance of food they afford, and the necessity of everywhere keeping in check their prolific legions, it is by no means surprising that, even among the higher quadrupeds, creatures are found specially constructed to wage war with the insect races.

The Shrew, the Hedgehog, and the Mole, are familiar British representatives of the families that constitute this order. They are all small plantigrade animals with short limbs. Their muzzle is more or less lengthened, and the molar teeth are furnished with small conical points, a structure that always indicates an insect diet.

The **Shrews** (*Sorex*) have their feet formed for walking or swimming, and are clothed with fur of delicate softness. They have a

Fig. 475.—shrew.

* Insectum, *an insect*, voro, *I devour* —*Insect-devourer*.

general resemblance to mice, but the snout is greatly lengthened. They are fond of the vicinity of water; and one pretty little species, figured above, is eminently aquatic. It swims and dives with great rapidity and elegance. The Shrews live in holes that they excavate in the earth. They rarely come out, except in the evening, and live entirely upon worms and insects. Like many other harmless and inoffensive creatures, they have been falsely accused of all sorts of iniquities, more especially of causing a disease in horses by their bite, and there are few parishes that have not, in former times, had their "Shrew ash" as a charm against witchcraft. Perhaps they owe their bad character to the circumstance that, although Cats will readily kill a Shrew, they refuse to eat it, on account of its disagreeable odour.

The **Hedgehogs** (*Erinaceus*) are distinguished by having their bodies covered more or less exclusively with spines instead of hairs. They have the faculty of rolling themselves up into a ball, and thus presenting only an array of prickles pointing in every direction.

The **Common Hedgehog** (*Erinaceus Europœus*) is well known in the rural districts of this country. Slow of foot, it cannot flee from

FIG. 476. – HEDGEHOG.

danger; but in the sharp, hard, and tough prickles of its coat it is endowed with a safeguard more secure and efficient than the teeth and claws of the wild cat, or the fleetness of the hare. The Hedgehog is provided with powerful muscles, beneath the skin of the back, whereby on the slightest alarm, it is able to roll itself up, so as to enclose the head and limbs in the centre. The more forcibly these muscles contract, the more rigidly do the spines project from every

part of its surface, so that it cannot be touched with impunity. A thorough-bred Terrier will, however, sometimes succeed in forcing open the poor "Urchin," at the expense of a bloody nose and sorely pricked paws. The young Hedgehogs, frequently called Hedgepigs, are born blind; the points of the pricks at the time of birth already project from the skin, but are soft and flexible. The female is a careful and attentive mother.

The **Moles** (*Talpa*) are everywhere distinguishable by their subterranean habits, and by their strange conformation, which is admirably

FIG. 477.—MOLE.

adapted to their mode of life. Their fore-limbs, very short, supported by a strong and vigorous construction of the shoulder; and wielded by muscles of enormous strength, resemble broad hands,

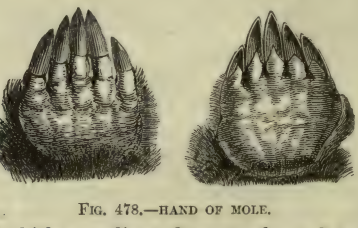

FIG. 478.—HAND OF MOLE.

the palms of which are directed outwards and backwards: the fingers are scarcely perceptible, but the nails at their extremities are long, flat, cutting, and of great strength, wonderfully contrived

for tearing up the earth, and casting it backwards, as the creature burrows through the soil, an operation in which it is assisted by its long pointed head and moveable snout. The hinder legs are very feeble, and the animal's movements upon the ground are as imbecile as they are efficient underneath it. Its hearing is very acute, but the eyes are so small, and so covered by the skin, that their very existence might be denied by a superficial observer. The fur of the Mole is very peculiar; the hairs, instead of projecting from the skin obliquely backwards, as in most animals, grow perpendicularly from the surface, so that, like the pile of velvet, they will lie with equal smoothness in any direction, thereby enabling the animal to retreat with facility through the narrow passages of its subterranean burrows.

Order VIII.—Bats.

Cheiroptera.*

The Mammiferous destroyers of insects are by no means restricted to the surface of the ground, or limited by their structure to the pursuit of a few beetles, or grovelling larvæ. Many, furnished with wings of strange conformation, are permitted to wage war against them even in their own element, rivalling the very Swallows in their power of flight.

The **Bats** have their arms, fore-arms, and fingers extremely elongated, and connected together by a delicate fold of skin spread over them, much in the same way that the silk of an umbrella is stretched upon its frame, so that they form real wings, as broadly expanded as those of birds. Accordingly, these creatures fly to a considerable height with great rapidity, and with apparent ease, wheeling in every direction in search of their insect prey, and performing the most abrupt evolutions to secure it. The muscles that wield their wings are possessed of strength proportionate to the movements they have to execute, and in the middle of the breast-bone there is a ridge or keel like that of birds, so as to form a larger surface for their attachment. The thumb is short, and armed with a hooked nail,

* χείρ, cheir, *the hand;* πτερόν, pteron, *a wing—hand-winged.*

whereby these animals suspend themselves from any foreign object, or creep upon the surface of the ground. Their hind feet are extremely small. Their ears are often remarkably spread out, so as to form, in conjunction with their wings, an enormous extent of surface, which is so sensitive, that the Bats can direct themselves into all the nooks of the gloomy labyrinths in which they reside, probably by feeling the impulses of the external air. They are nocturnal animals, and in our climate pass the winter in a state of lethargy. During the day they remain suspended in their dark retreats. They generally have two little ones at a birth, which they hold to their breast by means of their wing-like arms.

The Bats are divided into several families, some of which live upon fruits; such are

The **Fox-bats** (*Pteropus* *), common in the south of India, Japan, Madagascar, and Australia. They congregate in flocks, and selecting a large tree for their resting-place, suspend themselves by the claws of their hind limbs from the naked branches. They thus pass the greater portion of the day in sleep; but soon after sunset begin their nocturnal flight in search of food, directing their course to the forests, villages, and plantations, where they do great damage by devouring indiscriminately every kind of fruit; their flight is slow and steady, pursued in a straight line, and of long continuance.

The **Spear-nosed Bats** (*Phyllostoma* †) are distinguished by having a membrane, like an up-turned leaf, crossing the end of their noses. Their tongue is capable of great elongation, and terminated by little elevations, which seem to be so arranged as to form an organ of suction. All this tribe is American. They run on the earth with greater facility than any other Bats, and are accustomed to suck the blood of animals. To this tribe belongs

The **Vampire** (*Phyllostoma spectrum*), which has been accused of destroying even men. It is said generally to alight near the feet, and fanning the victim with its enormous wings, to bite a piece out of the tip of the great toe, so very small, that the head of a pin could scarcely be received into the wound, yet through this orifice it contrives to suck blood until gorged. It must not be imagined, however, that the Vampires are exclusively nourished by the blood of animals; they live on insects, after the manner of other Bats, as has been proved by inspection of the contents of their stomachs.

The **Horse-shoe Bats** (*Rhinolophus* ‡) have their nose furnished

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* πτερόν, pteron, *a wing;* ποῦς, pous, *a foot – wing-footed.*

† φυλλόν, phyllon, *a leaf;* στόμα, stoma, *a mouth—leaf-mouthed.*

‡ ῥίν, rhin, *the nose;* λόφος, lophos, *a crest.*

with membranes and crests of a very complicated description, occasionally presenting altogether somewhat the figure of a horse-shoe. They inhabit dark caverns, where they remain isolated, suspended by their feet, and enveloped in their wings.

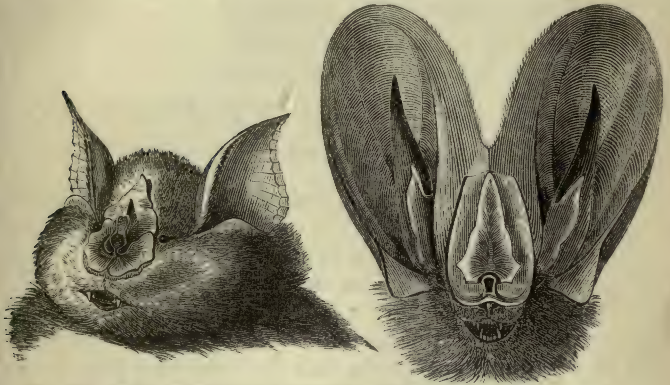

FIG. 479.—HEADS OF RHINOLOPHUS FERRUM EQUINUM AND MEGADERMA FRONS.

The **Common Bat** (*Vespertilio pipestrella*) is about the size of a mouse. Its body is covered with a short dusky fur, tinged with red; the eyes and the ears are small. This little Bat makes its appear-

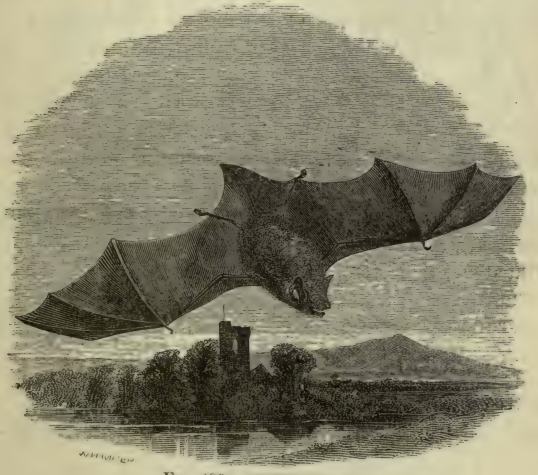

FIG. 480.—PIPISTRELLE.

ance in the twilight of fine summer evenings, frequenting the sides of woods, glades, and shady walks; or skimming over the surface of quiet waters, where moths, gnats, and other nocturnal insects are most abundant: but in stormy weather, it remains shut up in the chinks and fissures of old ruins, or concealed in hollow trees.

Order IX.—Mammalia with Four Hands.

Quadrumana.*

There yet remains a spacious region to be tenanted with fit inhabitants. The vast forests in many parts of the world constitute by no means an unimportant territory. Umbrageous solitudes, through which the foot of man has never found a path, covering whole countries with unbroken shade, where endless summer reigns, and fruits, and flowers, and foliage, in perpetual succession, furnish inexhaustible supplies of nourishment. In these dense woods, where giant trees are interlaced with creeping plants, innumerable **Monkeys** find their home, and spring from stem to stem, and bough to bough, with wonderful alacrity, making the woods alive with merry gambolings. The great feature whereby the Quadrumana are distinguishable, is that all their four feet are generally provided with *thumbs*, which are free and opposable to the other fingers. Although a few of them have a considerable resemblance to the human form, they progressively recede from it until the lower tribes walk exclusively on four legs, like ordinary quadrupeds. Nevertheless, the freedom of their arms, and the structure of their hands, allow many of them to imitate the gestures and actions of mankind with ludicrous exactness. The entire order is formed for living in the trees of tropical forests where the prehensile character of their feet renders them perfectly at home. Here they run, jump, and drop from bough to bough, or spring from tree to tree,

* Quatuor, *four;* manus, *a hand—four-handed.*

with wonderful agility, but poorly represented by any feats of a similar kind performed in a state of captivity. Another peculiarity in the construction of their hind feet, while it incapacitates them for walking in an erect position, admirably assists them in climbing. Their hinder hands, or feet, are incapable of being brought flat to the ground, as in man; but when endeavouring to stand, the soles nearly face

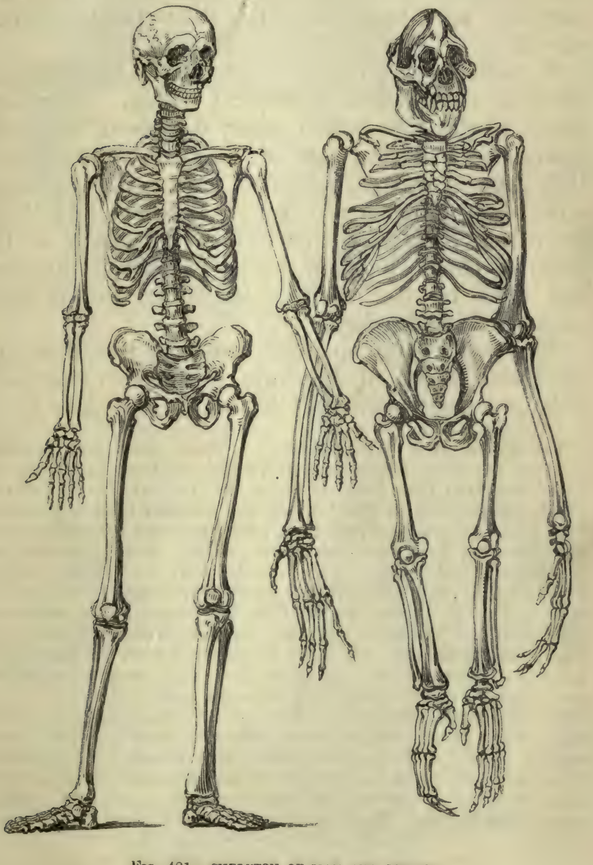

FIG. 481.—SKELETON OF MAN AND ORANG.

each other, and the body rests on the outer edge of the foot; their legs, too, are very short, bent, and directed inwards, so that they may be termed bow-legged. Their arms, moreover, are of inordinate length, and the fingers very long in proportion to the thumbs, so that their prehensile paws, when compared with the human hand, are extremely clumsy and inefficient. It is sufficient, indeed, to contrast the skeleton of man with that of one of the most man-like apes, to perceive the dissimilarity of their structure.

In their geographical distribution, the Quadrumana must be regarded as a tropical group. They are found in the forests and rocky deserts of Southern Asia, South Africa, and of South America, where they live in troops, and feed principally on fruits, often descending to plunder the gardens and fields. In Africa their range extends as far south as the Cape of Good Hope; a species of baboon-like monkey lives on the rock of Gibraltar, this is their most northern locality.

Intermediate in structure between the Bats and the lowest forms of Monkeys is a very remarkable tribe of animals, generally known by the name of

The **Flying Cats** (*Galeopithecus* *). These differ from the Bats in many important particulars; the fingers of their hands are not more elongated than those of their feet, so that the fold of skin which occupies the interval between the fore and hind legs can do little else than act as a parachute, enabling these creatures to take long sweeping leaps from tree to tree. These animals are found in the Indian Archipelago. They inhabit lofty trees in dark woods, to which they cling with all four limbs, and climb easily by means of their claws. During the day time they suspend themselves like Bats from the branches, with the head downwards, but at night they rouse themselves, and make an active search for food, which consists of fruits, insects, eggs, birds, &c. They are very inoffensive, and generally produce two young ones at a birth.

The **Fox-headed Monkeys** (*Lemur*). The animals belonging to this family have thumbs, both upon the fore and hind limbs, which are well developed, and opposable to the other fingers; but they differ from the monkeys in the disposition and character of their teeth, which are more or less studded with sharp points, indicative of their appetite for insects. Their muzzle is lengthened, and pointed, their

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* γαλέη, galee, *a weasel;* πίθηκος, pithecos, *an ape.*

nostrils are terminal, their feet thick and soft; and they are farther distinguishable, by having the nail of the forefinger of their posterior hands raised and sharp-pointed, while the nails of the other hands are flat. They are all very active, and have been named Fox Monkeys, on account of the shape of their heads. The Lemurs, pro-

FIG. 482.—WHITE-FRONTED LEMUR.

perly so called, exclusively inhabit the island of Madagascar, where they seem to take the place of the real monkeys. They live upon fruits and small animals, and some of them are trained to hunt like dogs.

The **Sloth Monkeys** (*Stenops* * *tardigradus* †) have acquired their name from the extreme slowness of their movements. They are nocturnal in their habits, living upon insects and small birds, which they approach stealthily in the dark. They inhabit the East Indies.

The **Marmozets** (*Hapale* ‡) constitute a little group peculiar to the New World. They are small, agreeable-looking animals, with a round head, flat face, lateral nostrils, and a bushy tail, which is not prehensile. On their anterior extremities their thumbs are scarcely opposable to their other fingers, and all their fingers except the

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* *στενός*, stenos, *narrow; ὄψ*, ops, *a face—narrow-faced.*

† Tardus, *slow;* gradior, *I walk—slow-walking.*

‡ *ἁπαλός*, hapalos, *soft.*

thumb of the posterior extremities, are armed with compressed nails, pointed like claws. By the aid of these nails they climb trees like squirrels, for the conformation of their hands does not permit them to seize hold of branches like monkeys.

The monkeys of the American continent are distinguished by having four more teeth than those of the Old World, making thirty-six in all; their tail is long, they have no cheek pouches, the hinder part of their body is hairy, and unprovided with callosities, and their nostrils are situated at the sides of the nose, not beneath it. They inhabit vast forests, and climb the trees with most surprising agility. Their lengthy tail serves them as a balancing pole, wherewith to keep their equilibrium while leaping, and some possess the power of wrapping its extremity round objects, and holding them with so tenacious a grasp, that the animal can thus suspend itself from

FIG. 483.—HOWLING MONKEY.

the branches as with a fifth hand. According to the difference of the conformation of the tail, the monkeys of America are divided into two principal groups.

1. Those that have the tail prehensile, or capable of being twisted round an object, so as to seize it, as with a hand, distinguished by the name of **Sapajous**, or **Capuchin Monkeys** (*Cebus*).

2. Those in which the tail is not at all prehensile, constituting the family of **Sakis** (*Pithecia*).

To the former division belong

The **Howling Monkeys** (*Mycetes* *), which, from a peculiar conformation of their throats, are gifted with voices of tremendous power and volume. Their howling, as travellers tell us, may be heard for half a league around. It is more especially at sunrise or sunset, or on the approach of a storm, that they make the forest re-echo with their frightful cries, and sometimes, as it would seem, they have recourse to this howling to drive away their enemies. These monkeys are very common in the great forests of Brazil.

The **Spider Monkeys** (*Ateles* †) have the thumbs on their fore-

FIG. 484.—ORANG-OUTANG, MANDRILL, AND SPIDER MONKEY.

* μυκητής, mycetes, *a bellower*.

† ἀτελής, ateles, *imperfect*—in allusion to their having only rudimentary thumbs.

hands either very minute or entirely wanting. Exclusively arboreal in their habits, the Spider Monkeys move on the ground with a vacillating gait, dragging themselves along by means of their long fore-arms, which they use like crutches, the fist being half closed; or they walk in a crawling position, sustaining themselves on their hind feet only, and balanced by their long arms, and tail extended ready to seize any object which may help progression. But among the branches of the trees their agility is almost equal to that of a bird; the sensitive tip of the long tail lays hold of a bough with the facility and security of a fifth hand, while its grasp is sufficiently powerful to sustain the weight of the body as it swings.

The monkeys of the eastern hemisphere differ from the American monkeys in their teeth, which are only thirty-two in number. Their nostrils are placed close together, separated only by a narrow partition, and in many species the tail is entirely wanting. They may be divided in accordance with the following Table:—

Tabular Arrangement of the Monkeys of the Old World.

Having neither a tail nor cheek-pouches . . .	Without callosities on the rump			**TROGLODYTES.**
	With callosities on the rump . . . , ... , . . .			**GIBBONS.**
Having a tail which is generally long, but sometimes a mere rudiment. Callosities on the rump . . .	Muzzle rounded moderately, projecting nostrils, situated at the end of the muzzle .	Tail very long, habitually raised, and serving as a balance . . .	With cheek-pouches	**GUENONS, or LONG-TAILED MONKEYS.**
			Without cheek-pouches. . .	**SEMNOPITHECUS.**
		Tail pendant, generally short, and not assisting in the movements of the animal.		**MACACUS.**
	Muzzle truncated at the end and very projecting, the nostrils open at its extremity—with cheek-pouches			**CYNOCEPHALUS.**

The **Baboons** (*Cynocephalus* *) are the most brutal and ferocious of the entire race, alike formidable for their size and strength; their limbs are short, and their usual mode of progression is on all fours. In leaping they display considerable agility, and frequent the wooded mountains and wildest rocks. They feed on fruit and vegetables, and do much damage by pillaging fields and gardens. The Baboons nearly all inhabit Africa. To these belong

The **Mandrills** (Fig. 484). These are amongst the most extraordinary and hideous creatures imaginable; their colour is a brown grey, inclining to olive, their chin is furnished with a lemon-coloured beard, their cheeks are of a brilliant blue, and their nose red, especially near the top, where it is bright scarlet, while the hinder part of the body is of a deep violet tint. These creatures attain to a very large size, and are justly feared by the negroes of the Guinea coast, where they are common.

The **Guenons** or **Long-tailed Monkeys** (*Cercopithecus*†) possess both callosities and cheek-pouches. The species are very numerous, and very various in their size and

FIG. 485.—KAHAU.

* *κύων, κυνός*, kuon, kunos, *a dog; κεφαλή*, cephale, *the head—dog-headed.*

† *κέρκος*, cercos, *a tail; πίθηκος*, pithecos, *a monkey.*

colour; they are distributed all over the African continent, live in large troops, and commit serious depredations in cultivated places; many of them are easily tamed; they are of moderate size, and in leaping from tree to tree display wonderful activity. We give, as an example, a figure of the Long-nosed Monkey, or Kahau, so called from its cry.

The **Magots** (*Inuus*) have the tail reduced to a mere rudiment. The common species, *Inuus sylvanus*, covered entirely with a brownish grey hair, although a native of Barbary, is met with on the southern coast of Spain, and has taken complete possession of the most inaccessible part of the rock of Gibraltar. It is the only animal of the order Quadrumana that inhabits Europe. It is easily taught, when young, to perform various tricks, and is frequently exhibited in our streets.

The **Gibbons** (*Hylobates* *) have callosities upon the hinder parts of their bodies, but have neither a tail nor cheek-pouches. They are found in the remotest parts of the continent of India, and the adjacent islands, where they inhabit dense and impenetrable forests.

The **Siamang** (*Simia* † *syndactyla* ‡) differs from the other Gibbons in having the second and third toes of the hinder limb partially joined together by a narrow fold of skin. These Apes live together in numerous bands. During the day they remain silent, concealed among the foliage of the trees, but in the early morning and evening, they make the woods to resound with their discordant and frightful cries. They seem to live under the guidance of active and vigilant chiefs. All take alarm at the slightest sound that they do not understand, and escape into the recesses of the forest.

The **Gorilla** (*Troglodytes* § *gorilla*) inhabits, so far as is at present known, a district extending to about two hundred miles north, and the same distance south, of the equator, and ranging, perhaps, to three hundred miles from the western coast of Africa. Of specimens shot by M. Du Chaillu, the largest male seems to have been at least six feet two inches in height, so that, making allowance for the shortness of the lower limbs, the dimensions of a full-grown male may be said to equal those of a man of eight or nine feet high; and it is only in their length that the lower limbs are disproportionate to the gigantic trunk; in the thickness and solidity of their bones, and in the strength of their muscles, these limbs are quite in keeping with the rest of the body. When in an upright position, the arms of the Gorilla reach to its knees; the hind hands are wide and of

* ὕλη, ule, *a wood or forest;* βαίνω, baino, *to go or traverse.*

† σιμός, simos, *flat-nosed.*

‡ σύν, syn, *together with;* δάκτυλος, dactylos, *a finger or toe—having conjoined toes.*

§ τρωγλη, trogle, *a hole or cave;* δύω, duo, *to enter—one who hides in caverns.*

amazing size and power. The great toe or thumb measures six inches in circumference The palms and soles, and the naked part of the face, are of an intense black colour, as is also the breast. The other parts are thickly clothed with hair of an iron-grey, except the head on which it is reddish brown, and the arms, where it is long and nearly black. The female is wholly tinged with red.

FIG. 486.—GORILLA.

The general appearance of this formidable Ape in his native woods may be gleaned from M. Du Chaillu's very graphic description:—"Suddenly, as we were yet creeping along in a silence which made a heavy breath seem loud and distinct, the woods were at once filled with a tremendous barking roar. Then the underbrush swayed rapidly just ahead, and presently stood before us an immense Gorilla. He had gone through the jungle on his all-fours, but when he saw our party he erected himself, and looked us boldly in the face.

"He stood about a dozen yards from us, and was a sight I think I shall never forget. Nearly six feet high (he proved four inches shorter), with immense body, huge chest, and great muscular arms, with fiercely glaring, large, deep-grey eyes, and a hellish expression

of face, which seemed to me some night-mare vision; thus stood before us the king of the African forest. He was not afraid of us; he stood there and beat his breast with his large fists till it resounded like an immense bass-drum, which is their mode of bidding defiance, meantime giving vent to roar after roar."

The **Ourang Outang** (*Troglodytes Satyrus*). This creature inhabits the interior of Borneo, and other large islands of the Indian Ocean, and when young, is said to resemble man more than any other animal. The body is covered with coarse reddish hair, the face is

FIG. 487.—BORNEAN ORANG.

smooth and of a bluish tint, and the thumbs of the hinder hands very short in comparison with the fingers. He is said sometimes to attain the height of seven feet, and possesses great strength and agility. He dwells in the wildest forests, and habitually keeps himself upon trees, which he climbs with the greatest rapidity, and springs from branch to branch with as much facility as the smaller monkeys. On the ground, on the contrary, the Ourang Outangs walk with difficulty, and are frequently obliged to place their hands

upon the earth, using their long arms to raise themselves up, and swing themselves forward, very much as a man would use a pair of crutches. When young they show a great deal of intelligence, attach themselves to those who have the care of them, and learn to imitate many of our actions.

The **Chimpanzee** (*Troglodytes niger*) is another of these approximations to the human form. In height it equals or even surpasses that of man. Its body is covered with black or dark-brown hair, scantily distributed in front. It is a native of Guinea and Congo, in Africa, and constructs a dwelling of leaves and foliage. It occasionally arms itself with sticks and stones, with which it drives away elephants,

FIG. 488.—CHIMPANZEE.

and combats the attacks of its enemies. When domesticated it becomes sufficiently docile to sit at a table, and take its food, as though in ridiculous burlesque of human manners.

ORDER—MAN (BIMANES).

Foremost of the mammiferous division of the animal creation stands MAN, constituting an order apart in the class to which he is zoologically related.

The highest of the quadrumana, as we have already seen, are constructed to reside amid the trees of the forests, but are ill adapted for treading on the ground, or for sustaining themselves in an upright position. The foot of Man, on the contrary, (a very different instrument from the hinder hand of the most man-like ape) is as admirably contrived for maintaining him in an erect posture as the prehensile limbs of the monkey are for its life among

the branches. The sole of the human foot is broadly expanded, to support the leg, placed vertically above it; the heel is cushioned beneath, so as to bear the whole weight of the body, without inconvenience. The toes are short, possessing little flexibility, and the great toe, the representative of the thumb, is placed upon the same plane as the rest. A foot thus constructed, although well suited for progression, is quite unserviceable as an instrument of prehension, and, seeing that the hands of Man are equally unadapted for walking, it follows that he is the only animal in creation that can with propriety be called two-handed and two-footed, *bi-manous* and *bi-ped.* Man therefore stands upon his feet only,

"Erect and tall,"

his hands and arms being left free for other purposes. The hands of Man, moreover, which derive so many advantages from their complete freedom, are equally remarkable for the perfection of their structure. The thumb, proportionately longer than in any quadrumanous animal, confers far greater facility in handling small objects. The nails are so arranged as to support the organs of touch without in any way interfering with the delicacy of their perceptions, and thus the human hand becomes at once an instrument of sense, and a machine of matchless capabilities.

A special attribute conferred upon Man alone of all the mammiferous races, is his power of articulating sounds, and thus communicating with his fellows by a mode of all others the most convenient, and if we add to this the facility he has acquired of recording by written characters the results of his experience, we perceive at once the superiority of his condition.

Thus placed above the brute creation, Man forms the culminating point of the great scheme of nature here below, while his intellectual superiority, and, much more, his immortal destiny, ally him closely with higher and unseen existences.

Our task is ended; and yet before bidding adieu to the reader, who has accompanied us through this long journey, let us pause to cast one parting look upon the wondrous spectacle presented to our contemplation. Earth and air and water filled with life, in infinite abundance, life in innumerable forms, equally beautiful, and yet so diverse. In reviewing the multitudinous races composing the animal kingdom, it has of course been necessary to describe consecutively the different classes and orders in which they are grouped by naturalists, as though they formed but one extended line, and thus in a somewhat arbitrary manner to assign to each a place in the lengthy procession. To suppose that such is their natural arrangement would, however, be to fall into a very serious error. Although widely separated in our pages, the Tiger-beetle and the Tiger are, in their respective spheres of action, pretty much of equal rank, and we are inclined to think that in its own element the Cuttle-fish holds as high a place among the Mollusca as the Lion does among quadrupeds. The "vast chain of being," therefore, composed of numerous successive links, exists only in the imagination of the poet, and the young naturalist would be grievously misled by the adoption of such an idea. The animal creation may be more properly compared to some vast city, from the gate of which several main thoroughfares diverge, each leading to a different quarter of the town, but all dividing into labyrinths of streets, inhabited by artizans of various occupations, busily labouring for the general welfare. It is only by such a view as this, that we can at all understand the intricate dependencies whereby so many creatures are combined in one vast system, carrying out harmoniously the laws imposed upon them by their GREAT CREATOR.

INDEX.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

CHAPTER X.

CHAPTER XI.

CHAPTER XII.

CHAPTER XIII.

CHAPTER XIV.

CHAPTER XV.

CHAPTER XVI.

CHAPTER XVII.

CHAPTER XVIII.

CHAPTER XIX.

CHAPTER XX.

CHAPTER XXI.

CHAPTER XXII.

CHAPTER XXIII.

CHAPTER XXIV.

CHAPTER XXV.

CHAPTER XXVI.

CHAPTER XXVII.

THE END.

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